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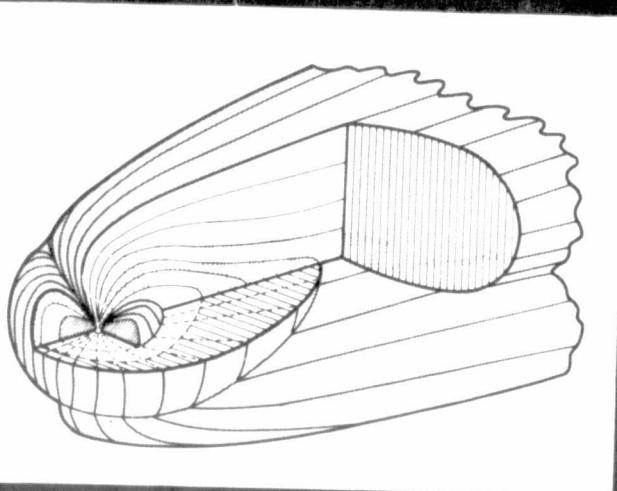
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# IMS/Satellite Situation Center Report

Orbit Plots and Bar Charts  
for Prognoz 4, Days 1-91 1976



REPORT NO. 8

DECEMBER 1976

IMS/Satellite Situation Center Report

Orbit Plots and Bar Charts for Prognoz 4

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National Space Science Data Center/  
World Data Center A for Rockets and Satellites  
National Aeronautics and Space Administration  
Goddard Space Flight Center  
Greenbelt, Maryland 20771

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## I. INTRODUCTION

This report contains orbit plots for the Prognoz 4 satellite for the time period January-March 1976. This satellite has been identified as a possible important contributor to the International Magnetospheric Study (IMS) project. The orbits are based on an element epoch of December 26, 1975, 3h 8 min and 17s. The elements are given in Table 1 and correspond to orbit number 2. In view of the low perigee of this satellite, the Satellite Situation Center (SSC) considers that the effect of atmospheric drag precludes orbit predictions for the length of time normally used by the SSC for high-altitude satellites. Consequently, orbit data are shown for the first 3 months of 1976 only. A second set of elements, corresponding to orbit number 10, is shown in Table 1. Both epochs correspond to the satellite at the ascending node. The orbit generated for this report is based on the earlier epoch, and it positions the satellite within 30s of the ascending node at the later epoch. Therefore, within the accuracy of the plots shown in this report, the orbit used may be regarded as an achieved orbit. The orbit information is displayed graphically in four ways: bar charts, geocentric solar ecliptic plots, boundary plots, and solar magnetic latitude versus local time plots.

The most concise presentation is the bar charts given in Appendix A. The bar charts give the crude three-dimensional position of the satellite for each magnetospheric region. Each page contains information for 4 days, and the length of the time axis corresponds to the IMS standard scale of 1 cm/h. A three-letter mnemonic is used to represent the various regions of space through which the Prognoz 4 satellite passes:

INP: interplanetary medium  
SHE: magnetosheath  
SPH: magnetosphere

When the satellite is in the magnetosheath or the magnetosphere, two lines of information are included beneath the mnemonic. The upper line corresponds to the latitude of the satellite, and the lower line corresponds to the local time of the satellite in the Solar Magnetic (SM) coordinate system. In the SM system, the Z-axis contains the north magnetic pole, and the Y-axis is perpendicular to the Earth-Sun line toward dusk. When the satellite is in the interplanetary medium, a third line is added corresponding to the distance, in Earth radii, between the satellite and the Earth's bow shock wave; the notation,  $\bar{r}$ , denotes a negative distance and indicates that the satellite is on the convex side of the bow shock boundary. Fairfield's model for the average position of the bow shock has been used (Fairfield, 1971). This model corresponds to a solar wind bulk speed of 420 km/s. A vertical line is drawn when the satellite crosses from one region to the next. The boundary crossings, bow shock (S) and magnetopause (P), appear at the crossing time above the satellite box. Fairfield's model for the average position of the magnetopause boundary has been used.

In Appendix B, the orbit plots of Prognoz 4 are shown in a Geocentric Solar Ecliptic (GSE) X-Y projection. In the GSE coordinate system, the X-axis is along the Earth-Sun line toward the Sun, and the Z-axis is perpendicular to the ecliptic plane such that the Y-axis is toward dusk. In the projection used, a cylindrical rotation of the Y and Z components of the satellite radius vector has been performed at constant X in order to show the relative positions of the satellite and the magnetopause and bow shock boundaries. Each GSE plot contains approximately 3 days of ephemeris data indicated by the start and stop time at the base of each plot. Approximate boundary crossing times are indicated by tick marks on the projected orbit. More accurate boundary crossing times are given by the bar charts presented in Appendix A and the boundary plots presented in Appendix C. The distance of the satellite from both bow shock (S) and magnetopause (P) can be determined for any given time. The

actual distance plotted is the projection of the distance between the satellite and the boundary onto the normal to the boundary drawn at the intersection of the boundary and the satellite-Earth line. Positive distances are on the concave side of the surfaces. On a second frame, the ecliptic latitude and longitude are shown in order to give a three-dimensional image of the satellite position. Each frame covers a 24-h period, and only those days are shown for which a boundary crossing occurs.

On many of the boundary plots, a sharp discontinuity can be seen. This indicates that the satellite radial distance becomes less than 4 Earth radii. The distance to the boundaries is not shown for these radial distances and appears as a default value of either +20 Earth radii or -20 Earth radii.

Because Prognoz 4 lies in a high-inclination orbit, it passes close to the direct access or cusp region. In Appendix D, the Prognoz 4 orbit is shown projected onto the surface of the Earth in the SM latitude-local time plane. The northern and southern cusp regions are shown as broken lines. Following Heikkila (1972), the cusp region is taken as magnetic local times in the range of 8h to 16h and magnetic latitudes in the range of  $75^{\circ}$  to  $80^{\circ}$  north or south. With this type of projection, the satellite may appear to be in the cusp when, in reality, it is in the magnetosheath. These instances are indicated on the plot. Each plot contains approximately 3 days of ephemeris data indicated by the start and stop times at the base of the plot.

## II. PROGNOZ 4 ORBIT CHARACTERISTICS FOR DAYS 1-91 1976

As may be seen from the GSE plots in Appendix B, the apogee of Prognoz 4 for the time period covered lies in the interplanetary medium. Consequently, the satellite does not enter the magnetotail and, on the average, spends 64.4 percent of the time in the interplanetary medium, 7.2 percent in the dayside magnetosheath, 11.2 percent in the nightside magnetosheath, 6.2 percent in the dayside magnetosphere, and 11.0 percent in the nightside magnetosphere. These percentages vary only a small amount on a per-revolution basis.

It may be seen from the boundary plots in Appendix C that most boundary encounters occur at high latitudes as a consequence of the high inclination of the satellite. The times of the boundary encounters are listed in Table 2 for the bow shock and in Table 3 for the magnetopause. For most of the time period, the inbound encounters occur on the dayside, and the outbound encounters on the nightside.

Although Prognoz 4 is a high-inclination satellite, no encounters with either the northern or southern cusp regions are observed. However, this region is highly variable, and a number of close approaches may be observed in the SM plots in Appendix D. (These plots should be used with the GSE plots in order to determine if the satellite is inside the magnetosphere.)

### III. SPACECRAFT EXPERIMENT BRIEF DESCRIPTIONS

Spacecraft Common Name - Prognoz 4

NSSDC ID - 75-122A

Last Reported State - Launched and Operating Normally

Launch Date - 12/22/75

Sponsoring Country/Agency

U.S.S.R./Academy of Sciences

Orbit Parameters

See Table 1

Spacecraft Personnel

Scientific Coordinator - A. A. Galeev.....Space Research Institute  
Academy of Sciences  
Moscow  
U.S.S.R.

Spacecraft Brief Description

The spacecraft is a contribution to the IMS program that carries experiments to investigate solar corpuscular, X-ray, and radio emissions as well as to measure energetic particles, plasma, and magnetic fields in the magnetosphere and the interplanetary medium. In a cooperative program with scientists of the Socialist countries, sounding rockets will be launched to altitudes greater than 500 km to study the interaction of shortwave solar radiation with the atmosphere and ionosphere and to make in situ measurements of various parameters in these regions of space.

Experiment Name - Three-Axis Fluxgate Magnetometer

NSSDC ID - 75-122A-01

Last Reported State - Launched and operating normally at the standard data acquisition rate since 12/22/75.

Experiment Personnel (PI = Principal Investigator)

PI - Sh. Sh. Dolginov.....IZMIRAN  
Academy of Sciences  
Moscow  
U.S.S.R.

Experiment Brief Description

The instrument is a three-axis fluxgate magnetometer with a single range sensitive to field intensities of 0 to 600 gammas. The residual field is approximately 1 gamma.

Experiment Name - Plasma Detector

NSSDC ID - 75-122A-02

Last Reported State - Launched and operating normally at the standard data acquisition rate since 12/22/75.

Experiment Personnel (PI = Principal Investigator)

PI - K. I. Gringauz.....Space Research Institute  
Academy of Sciences  
Moscow  
U.S.S.R.

Experiment Brief Description

The instrument consists of a differential ion probe that measures the spectrum between 0.1 and 4.4 keV and an electron probe that measures the density and temperature for energies less than 300 eV. Because of the nature of the orbit, plasma parameters will be obtained in the solar wind, magnetosphere, and plasmasphere.

Experiment Name - Solar X Rays

NSSDC ID - 75-122A-03

Last Reported State - Launched and operating normally at the standard data acquisition rate since 12/22/75.

Experiment Personnel (PI = Principal Investigator)

PI - G. Ye. Kacharov.....Physical-Technical Institute  
Academy of Sciences  
Leningrad  
U.S.S.R.

Experiment Brief Description

The instrument measures X rays in the energy range 2-511 keV.

Experiment Name - Energetic Particles and Charge Composition

NSSDC ID - 75-122A-04

Last Reported State - Launched and operating normally at the standard data acquisition rate since 12/22/75.

Experiment Personnel (PI = Principal Investigator)

PI - Yu. I. Logachev.....Institute of Nuclear Physics  
Moscow State University  
Moscow  
U.S.S.R.

PI - I. A. Sanenko.....Institute of Nuclear Physics  
Moscow State University  
Moscow  
U.S.S.R.

Experiment Brief Description

The instrument consists of various detectors to measure the spectra, anisotropy, and charge composition. The charge composition at energies above 500 MeV per nucleon is obtained at charge values for Z from 2 to 6, 6 to 15, 15 to 35, and 35 to 50.

Experiment Name - Kilometric/Hectometric Receiver

NSSDC ID - 75-122A-05

Last Reported State - Launched and operating normally at the standard data acquisition rate since 12/22/75.

Experiment Personnel (PI = Principal Investigator)

PI - Slysh.....Space Research Institute  
Academy of Sciences  
Moscow  
U.S.S.R.  
PI - Grigoreva.....GAISH  
Academy of Sciences  
Moscow  
U.S.S.R.

Experiment Brief Description

The instrument is a receiver-antenna system that measures radio emission in the 50-1000 kHz band in 10 frequency intervals.

REFERENCES

Fairfield, D. H., "Average and Unusual Locations of the Earth's Magnetopause and Bow Shock," J. Geophys. Res., 76, 28, 6700, October 1971.

Heikkila, W., "Penetration of Particles into the Polar Cap Regions of the Magnetosphere," Critical Problems of Magnetospheric Physics, Proceedings of the Joint COSPAR/IAGA/URSI Symposium, Madrid, May 1972.

Table 1. ORBIT PARAMETER SUMMARY TABLE FOR PROGNOZ 4

International ID	1975-122A	1975-122A
Epoch (YY-MM-DD-HH-MM-SS)	75-12-26-03-08-17	76-01-26-23-42-11
Period (min)	5785.50	5778.17
Eccentricity	0.93447	0.92976215
Inclination (deg)	64.99	65.28
R.A. of Ascending Node (deg)	157.802	156.681
Argument of Perigee (deg)	289.998	289.57396
Mean Anomaly (deg)	1.112	1.247
Semimajor Axis (km)	106755.22	106664.70
Perigee Height (km)	617.58	1113.74
Apogee Height (km)	200136.56	199459.34

Table 2. PROGNOZ 4 BOW SHOCK CROSSINGS, DAYS 1-91 1976

Time (day/h)	Time (day/h)	Time (day/h)
2/11.48	34/10.91	63/17.94
3/21.23	35/19.35	66/7.96
6/11.55	38/10.64	67/17.68
7/20.93	39/19.09	70/7.47
10/11.57	42/10.38	71/17.45
11/20.63	43/18.89	74/6.98
14/11.60	46/10.12	75/17.33
15/20.39	47/18.79	78/6.42
18/11.61	50/9.79	79/17.16
19/20.26	51/18.65	82/5.78
22/11.54	54/9.37	83/16.87
23/20.09	55/18.40	86/5.10
26/11.37	58/8.93	87/16.59
27/19.82	59/18.17	90/4.39
30/11.16	62/8.46	91/16.31
31/19.58		

Table 3. PROGNOZ 4 MAGNETOPAUSE CROSSINGS, DAYS 1-91 1976

Time (day/h)	Time (day/h)	Time (day/h)
2/19.26	34/16.62	63/6.35
3/10.90	35/8.59	66/13.32
6/18.95	38/16.23	67/5.95
7/10.58	39/8.25	70/12.89
10/18.64	42/15.87	71/5.58
11/10.26	43/7.96	74/12.47
14/18.35	46/15.52	75/5.27
15/9.99	47/7.73	78/11.99
18/18.08	50/15.12	79/4.91
19/9.78	51/7.46	82/11.47
22/17.76	54/14.68	83/4.45
23/9.54	55/7.09	86/10.95
26/17.40	58/14.23	87/3.99
27/9.23	59/6.72	90/10.41
30/17.01	62/13.78	91/3.52
31/8.90		

## **APPENDIX A**

### **BAR CHARTS**

		INP			
DAY		8r	8r	7r	6r
1		55N	46N	56N	66N
		11H	12H	14H	12H

		S	P	
DAY		INP	SHE	SPH
2		5r	3r	1r
		51N	41N	39N
		11H	12H	14H
			41N	49N
			14H	14H
				52N
				45N - 25N
				13H - 14H

		P	S	
DAY		SPH	SHE	INP
3		25N	38S	50N
		59N	59N	56N
		14H	1H	0r - 1r
		7H	9H	56N
		9H	10H	9H
			73N	65N
			11H	8H
			9H	8H
			76N	56N
			8H	9H
			71N	65N
			8H	9H

		INP			
DAY		1r	4r	6r	7r
4		55N	51N	55N	64N
		9H	11H	12H	13H
				72N	65N
				12H	10H
					55N
					10H



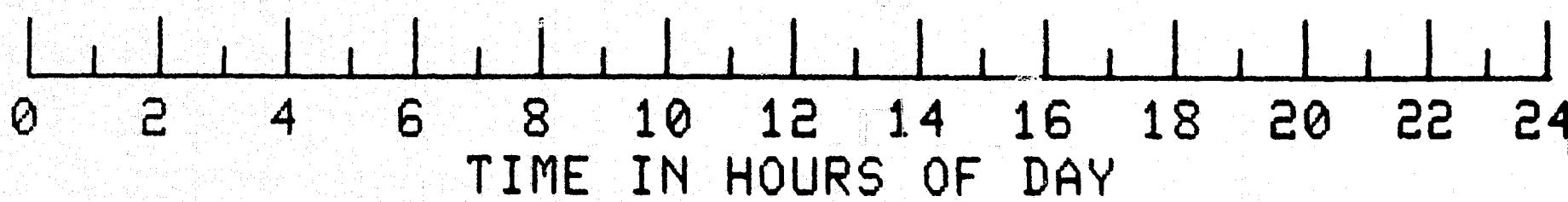
TIME IN HOURS OF DAY

INP	
8r	8r
54N	48N
10H	11H
46N	50N
12H	13H
57N	64N
13H	13H
66N	59N - 51N
12H	11H - 11H

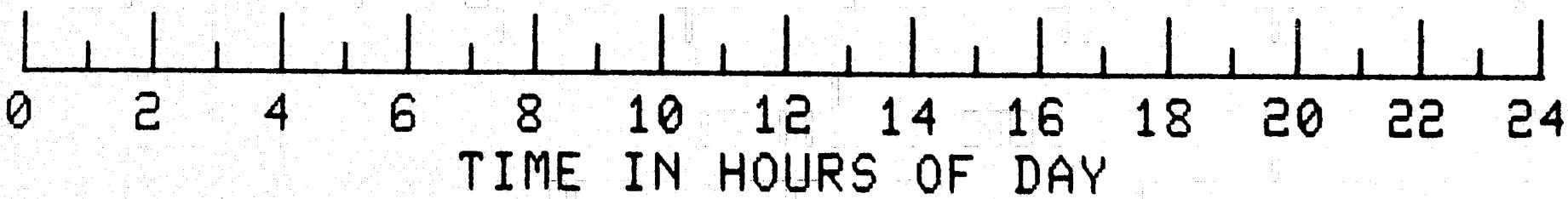
S	P	SPH
INP	SHE	SPH
5r	3r	1r
50N	42N	39N
11H	12H	13H
42N	45N	51N
14H	14H	14H
52N	43N - 19N	13H - 14H

P	S	INP
SPH	SHE	0r 1r 1r
19N - 18N - 52N - 59N - 65N	72N - 75N	62N - 55N
14H - 4H - 7H - 8H - 10H	10H - 10H	8H - 9H

INP	
2r	4r
55N	51N
9H	10H
55N	65N
12H	13H
72N	7r
11H	8r
65N	53N
10H	10H



		INP		
DAY	8r 53N 10H	8r 46N 12H	8r 57N 13H	7r 66N 12H
9				6r 49N 11H
		S		P
		INP	SHE	SPH
DAY	5r 49N 11H	3r 42N 12H	1r 39N 13H	42N 14H
10			45N 14H	52N 13H
				30N 13H
				10N 14H
		P		S
		SPH	SHE	INP
DAY	10N 14H	34N 4H	54N 7H	60N 8H
11			68N 10H	74N 10H
				76N 9H
				69N 8H
				0r 61N 8H
				1r 55N 9H
				1r 53N 9H
		INP		
DAY	2r 54N 9H	4r 51N 10H	6r 53N 11H	7r 59N 12H
12			67N 12H	72N 11H
				69N 10H
				60N 9H
				53N 10H



		INP						
DAY		8F	8F	8F	7F		6F	
13		52N	46N	50N	59N	66N	60N	49N
		10H	11H	12H	13H	12H	11H	11H

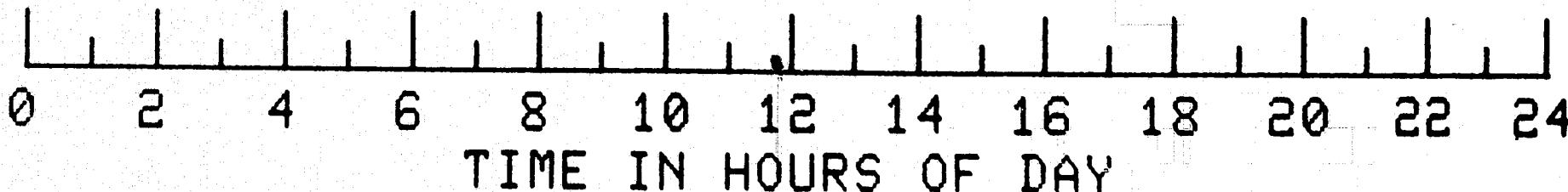
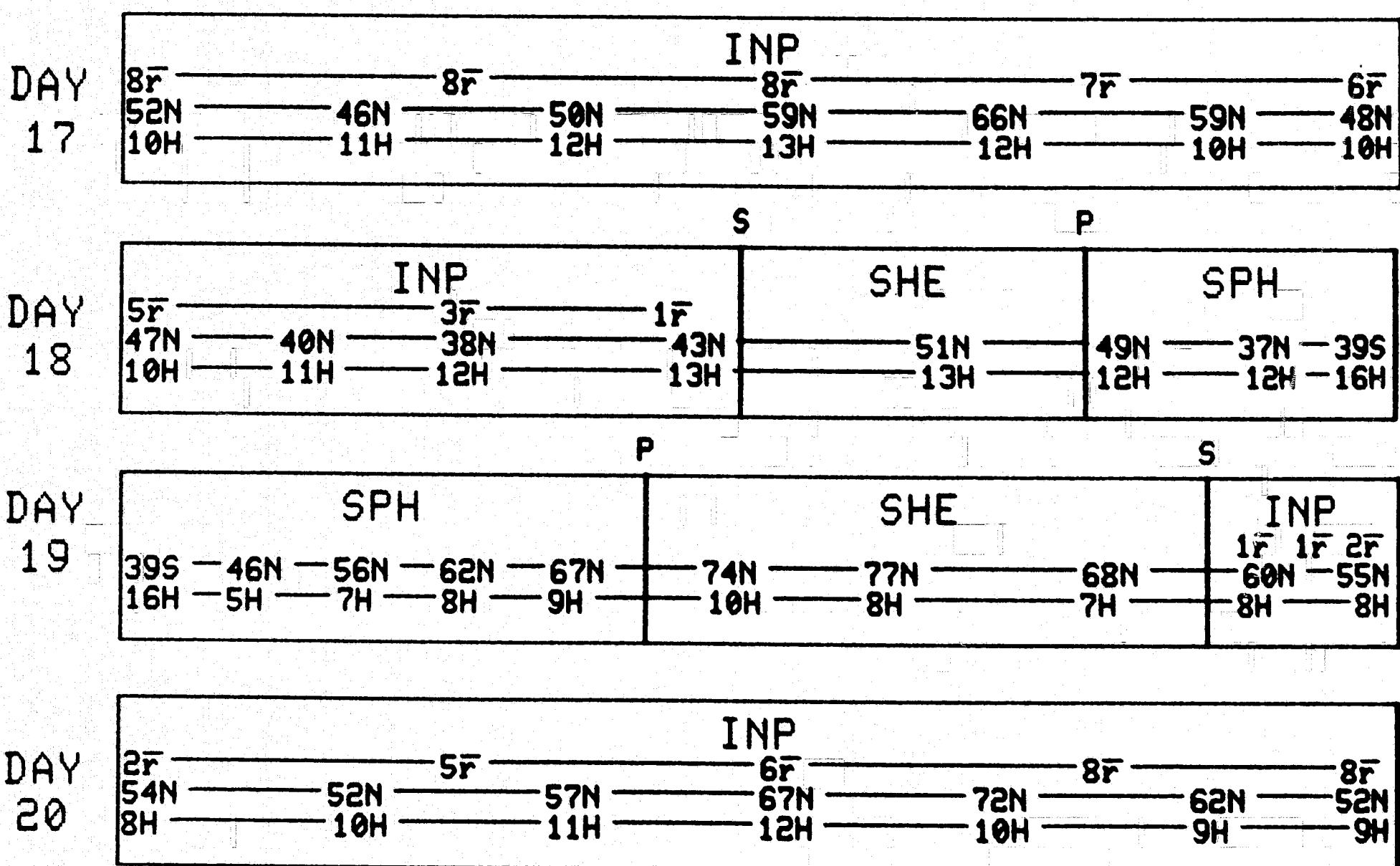
		S	P	
DAY		INP	SHE	SPH
14		5F	3F	1F
		47N	39N	48N
		11H	12H	13H
			43N	32N - 2S
			47N	13H
			52N	13H - 14H

		P	S	
DAY		SPH	SHE	INP
15		10S - 43N - 55N - 61N - 69N	75N - 76N - 69N	0r 1F 2F
		15H - 5H - 7H - 8H	10H - 8H	60N - 55N
				8H - 8H

		INP							
DAY		2F	4F	6F	8F	8F	8F	8F	8F
16		54N	51N	53N	59N	67N	72N	68N	60N - 53N
		9H	10H	11H	12H	12H	11H	9H	9H - 10H



TIME IN HOURS OF DAY



DAY  
21

INP

8r ————— 8r ————— 8r ————— 7r ————— 6r  
51N ————— 46N ————— 50N ————— 55N ————— 60N ————— 66N ————— 64N ————— 56N ————— 48N  
9H ————— 11H ————— 12H ————— 12H ————— 12H ————— 12H ————— 10H ————— 10H ————— 10H

S

P

DAY  
22

INP

5r ————— 3r ————— 1r  
46N ————— 40N ————— 38N ————— 43N ————— 47N ————— 51N ————— 48N ————— 34N ————— 23S  
10H ————— 11H ————— 12H ————— 13H ————— 13H ————— 13H ————— 12H ————— 12H ————— 0H

SHE

SPH

DAY  
23

SPH

23S ————— 48N ————— 57N ————— 63N ————— 72N ————— 77N ————— 73N ————— 68N ————— 0r 1r ————— 2r  
0H ————— 5H ————— 7H ————— 8H ————— 9H ————— 8H ————— 7H ————— 7H ————— 62N ————— 54N  
————— 7H ————— 8H

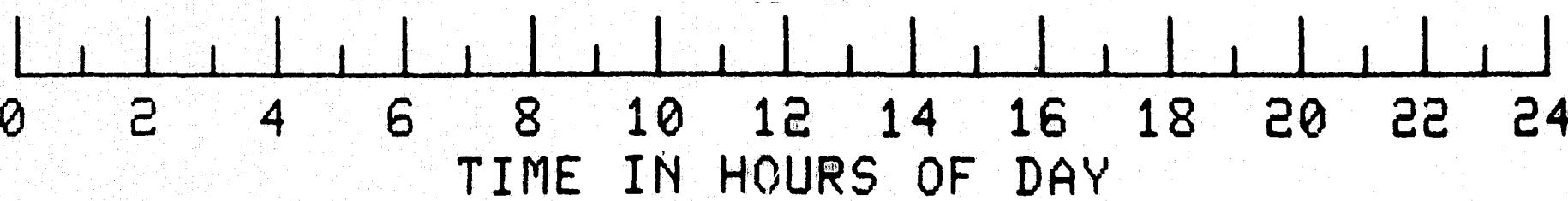
SHE

INP

DAY  
24

INP

2r ————— 5r ————— 6r ————— 8r ————— 8r  
54N ————— 52N ————— 58N ————— 62N ————— 68N ————— 72N ————— 68N ————— 59N ————— 51N  
8H ————— 10H ————— 11H ————— 11H ————— 11H ————— 10H ————— 9H ————— 9H ————— 9H



DAY  
25

	INP					
8r	9r	8r	7r			6r
51N	46N	50N	60N	66N	59N	46N
9H	10H	12H	12H	11H	10H	10H

DAY  
26

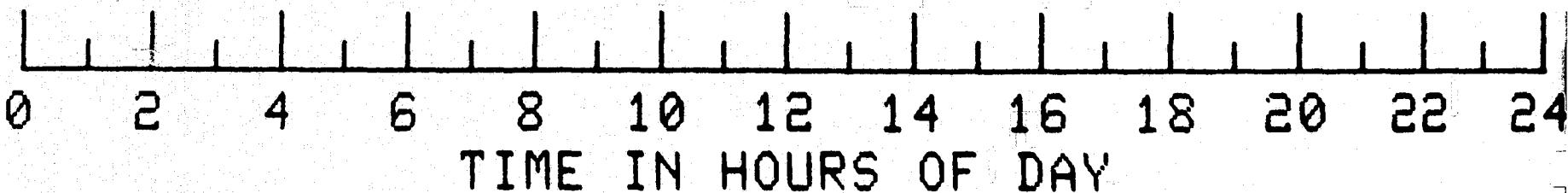
	S	P	
	INP	SHE	SPH
6r	3r	1r	
46N	40N	38N	43N
10H	11H	12H	12H

DAY  
27

	P	S	
	SPH	SHE	INP
18N	50N	58N	0r
2H	5H	7H	1r
	8H	9H	2r
		8H	61N
		7H	54N
		7H	7H
			8H

DAY  
28

	INP					
2r	5r	7r	8r			8r
53N	52N	59N	64N	69N	72N	66N
8H	10H	11H	11H	11H	9H	8H
						9H

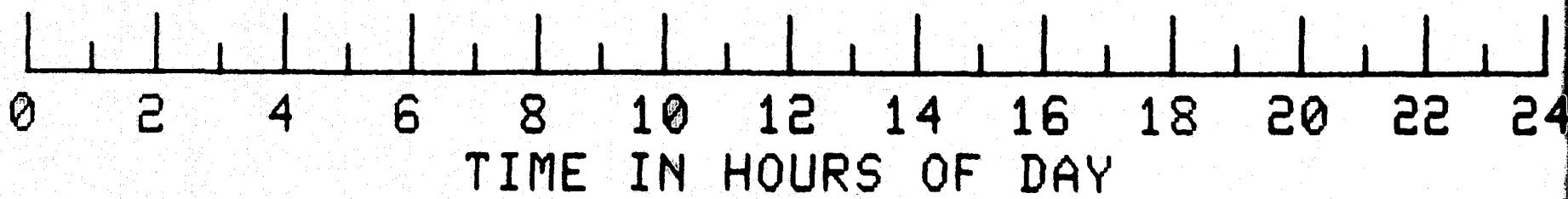


		INP									
DAY	9r	9r	8r	7r	8r						
29	50N	47N	48N	54N	62N	66N	62N	53N	46N		
	9H	10H	11H	12H	12H	11H	10H	9H	10H		

		S	P	
DAY	INP	SHE	SPH	
30	5r	3r	1r 0r	
	44N	39N	38N	44N
	10H	11H	12H	12H

		P	S	
DAY	SPH	SHE	INP	
31	35N	52N	59N	64N
	3H	5H	7H	8H
	9H	8H	7H	6H
	6H	6H	6H	7H
	0r	1r	2r	
	60N	53N	57N	50N
	7H	8H	8H	9H

		INP									
DAY	2r	5r	7r	8r	8r						
32	53N	52N	59N	65N	70N	72N	66N	57N	50N		
	8H	9H	11H	11H	11H	9H	8H	8H	9H		

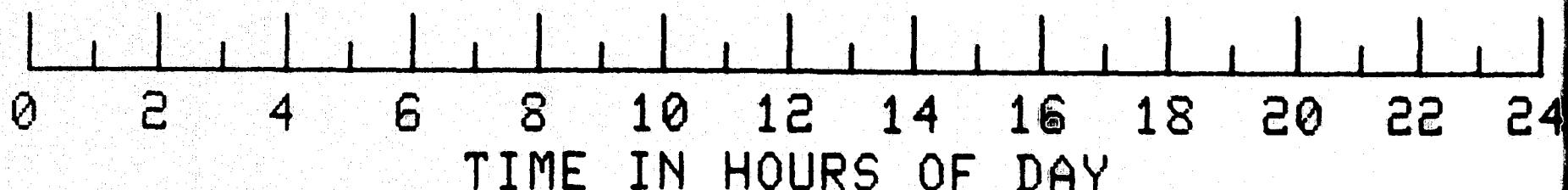


	INP							
DAY	9r	9r	8r	7r	6r			
33	50N	47N	52N	57N	62N	66N	56N	45N
	9H	10H	11H	11H	11H	10H	9H	10H

	S	P	
	INP	SHE	SPH
DAY	5r	3r	1r 0r
34	44N	39N	38N
	10H	10H	11H
		12H	12H
		12H	11H
			12H
			3H

	P	S	
	SPH	SHE	INP
DAY	SPH	SHE	INP
35	40N	54N	0r
	3H	5H	1r
	6H	8H	2r
	8H	8H	65N
			60N
			53N
			7H
			7H

	INP							
DAY	3r	5r	7r	8r	9r			
36	53N	52N	56N	63N	70N	72N	65N	56N - 50N
	8H	9H	10H	10H	10H	9H	8H	8H

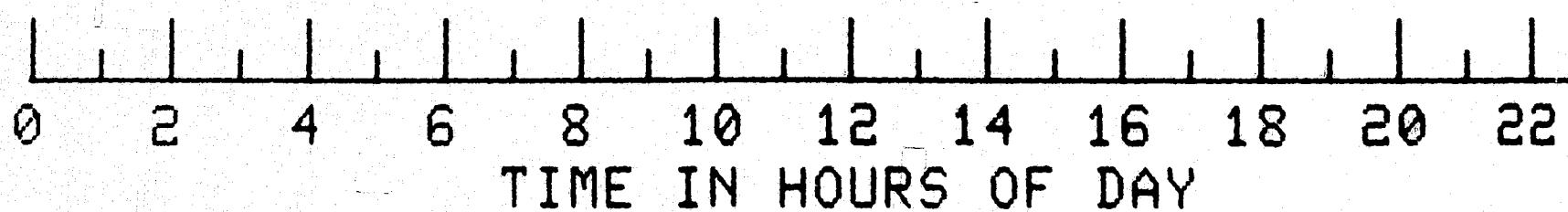


INP		SHE		SPH	
DAY 37	9r 49N 9H	9r 47N 9H	8r 55N 11H	7r 63N 11H	6r 66N 10H

INP		SHE		SPH	
DAY 38	5r 44N 9H	3r 38N 10H	1r 43N 12H	48N 12H	50N 11H

SPH		SHE		INP	
DAY 39	44N — 55N — 60N — 65N 3H — 5H — 6H — 7H	70N 8H	77N 7H	73N 6H	65N — 62N — 53N 6H — 6H — 7H

INP							
DAY 40	3r 53N 7H	5r 52N 8H	7r 56N 10H	8r 63N 10H	72N 8H	8r 65N 8H	9r 56N 8H



DAY  
41

INP									
9r	—	9r	—	8r	—	7r	—	6r	
49N	—	47N	—	49N	—	55N	—	63N	—
8H	—	9H	—	10H	—	11H	—	10H	—
									9H — 9H

DAY  
42

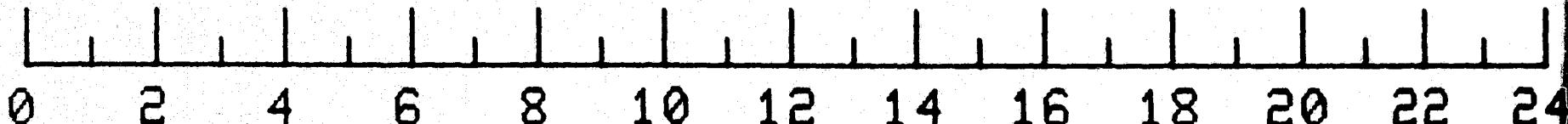
S	P	
INP	SHE	SPH
5r	3r	1r
43N	38N	43N
9H	10H	11H

DAY  
43

P	S	
SPH	SHE	INP
47N — 56N — 61N — 66N	73N — 77N — 71N — 66N	0r 1r — 2r
3H — 5H — 6H — 7H	8H — 7H — 5H — 6H	61N — 56N — 53N
		6H — 6H — 7H

DAY  
44

INP									
3r	—	5r	—	7r	—	8r	—	9r	
52N	—	57N	—	65N	—	72N — 71N	—	63N	—
7H	—	9H	—	10H	—	9H — 8H	—	7H	—
									8H — 8H



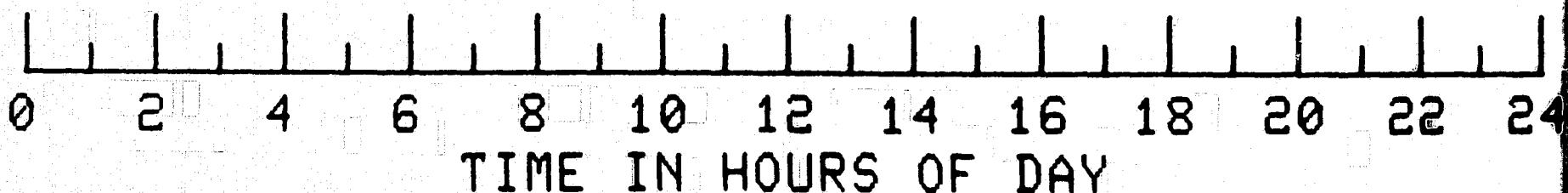
TIME IN HOURS OF DAY

	INP				
DAY	9r	9r	8r	7r	6r
45	48N	47N	54N	64N	66N
	8H	9H	10H	10H	9H

	S	P	
	INP	SHE	SPH
DAY	5r	2r	0r
46	42N	38N	39N
	9H	10H	11H
	11H	11H	11H

	P	S	
	SPH	SHE	INP
DAY	49N	74N	0r
47	57N	77N	1r
	62N	71N	2r
	67N		60N
			56N
	3H	8H	53N
	5H	6H	6H
	6H	5H	6H
	7H		7H

	INP				
DAY	3r	5r	7r	8r	9r
48	52N	58N	65N	72N	68N
	7H	9H	10H	9H	7H



DAY  
49

9r ————— 9r ————— 8r ————— 7r ————— 5r  
48N ————— 47N ————— 55N ————— 64N ————— 66N ————— 59N ————— 49N ————— 43N  
8H ————— 9H ————— 10H ————— 10H ————— 9H ————— 8H ————— 8H ————— 9H

**DAY  
50**

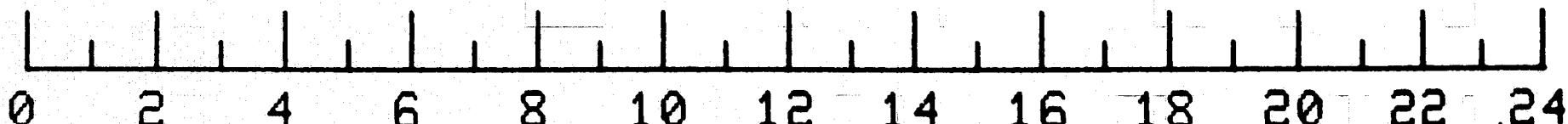
5r ————— 2r ————— 1r · 0r  
42N ————— 38N ————— 43N ————— 48N ————— 47N ————— 35N ————— 31S ————— 51N  
9H ————— 10H ————— 11H ————— 11H ————— 11H ————— 11H ————— 22H ————— 3H

DAY  
51

SPH	SHE	INP
51N - 57N - 63N - 67N	74N - 77N - 71N	0r 1r — 2r 60N — 56N - 52N

DAY  
52

**3r** ————— **5r** ————— **7r** ————— **8r** ————— **9r**  
**52N** ————— **58N** ————— **72N** ————— **62N** ————— **48N**  
**7H** ————— **9H** ————— **9H** ————— **7H** ————— **8H**



## TIME IN HOURS OF DAY

DAY  
53

	INP				
9r	9r	8r	7r	5r	5r
48N	51N	66N	58N	42N	
8H	10H	9H	8H		9H

DAY  
54

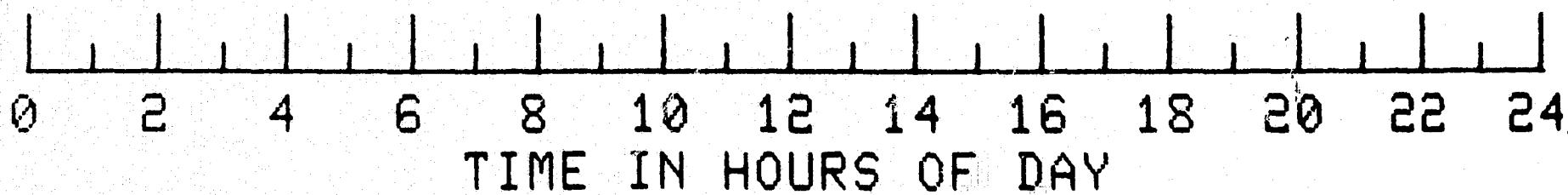
	S	P	
	INP	SHE	SPH
5r	2r	1r	
41N	39N	45N — 48N	47N — 24S — 52N
9H	10H	11H — 11H	10H — 13H — 0H — 3H

DAY  
55

	P	S	
	SPH	SHE	INP
52N	68N	77N	0r 1r — 2r
3H	7H	6H	60N — 52N
			5H — ?H

DAY  
56

	INP				
3r	5r	7r	8r	9r	
52N	58N	72N	62N	48N	
7H	9H	8H	7H	8H	



DAY  
57

	INP				
9F	9F	8F	7F	5F	
48N	51N	66N	58N	41N	
8H	9H	9H	8H	8H	

DAY  
58

	S	P	
5F	2F	1F	
41N	38N	42N	
8H	10H	10H	

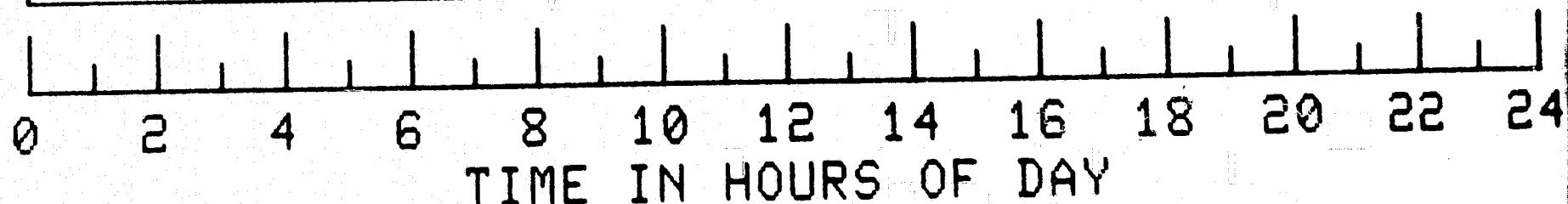
INP	SHE	SPH
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DAY  
59

	P	S	
SPH	SHE	INP	

DAY  
60

	INP				
3F	5F	7F	8F	9F	
52N	60N	72N	60N	48N	
7H	9H	8H	6H	7H	

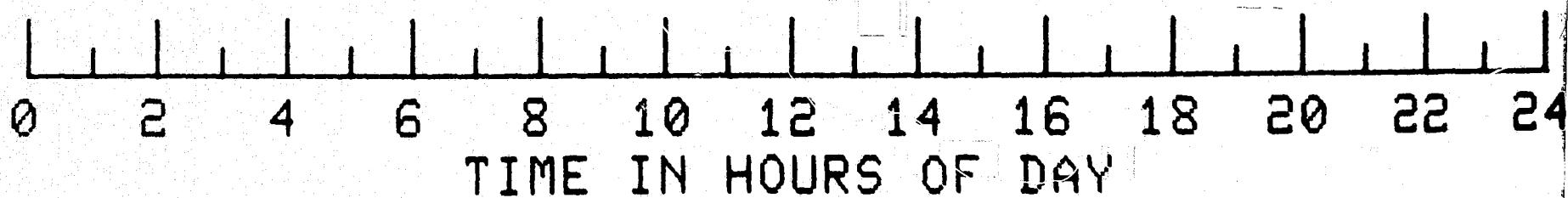


	INP				
DAY	9r	8r	8r	7r	5r
61	47N	52N	66N	56N	41N
	8H	9H	9H	8H	8H

	S	P	
	INP	SHE	SPH
DAY	4r	3r	1r 0r
62	40N	37N	41N
	8H	9H	10H

	P	S	
	SPH	SHE	INP
DAY	54N	67N	0r 1r
63	4H	6H	3r
		77N	52N
		5H	6H

	INP				
DAY	3r	5r	7r	8r	8r
64	52N	60N	72N	59N	48N
	7H	8H	9H	7H	7H



DAY  
65

	INP			
8r	8r	8r	6r	5r
47N	53N	66N	56N	40N
7H	9H	SH	7H	8H

DAY  
66

	S	P	
INP	SHE	SPH	

4r	3r	1r 0r	
40N	37N	41N	47N
8H	9H	10H	17H 0H

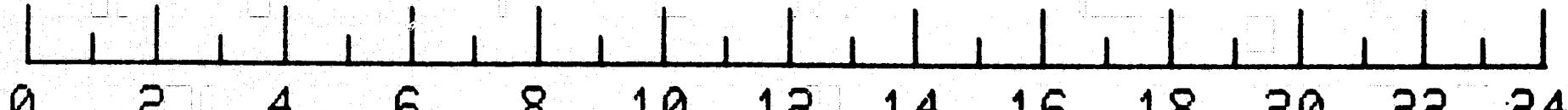
DAY  
67

	P	S	
SPH	SHE	INP	

55N	70N	77N	0r 1r
3H	6H	5H	60N

DAY  
68

	INP			
3r	5r	7r	8r	8r
52N	61N	72N	59N	47N
6H	8H	7H	6H	7H



TIME IN HOURS OF DAY

DAY  
69

	INP			
8r	8r	8r	6r	4r
47N	53N	66N	55N	40N
7H	9H	8H	7H	8H

DAY  
70

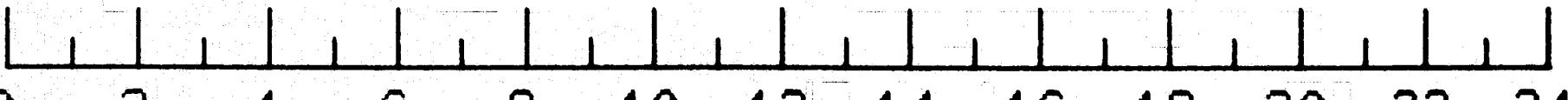
	S	P	
INP	SHE	SPH	
4r 39N 8H	3r 37N 9H	1r 0r 43N 10H	46N 9H
			8S 22H 0H 3H

DAY  
71

	P	S	
SPH	SHE	INP	
56N 3H	71N 6H	77N 5H	0r 1r 59N 4H
			3r 52N 6H

DAY  
72

	INP			
3r 52N 6H	5r 61N 8H	7r 72N 7H	8r 59N 5H	8r 47N 6H
				7H



TIME IN HOURS OF DAY

DAY  
73

	INP				
8r	8r	7r	6r	4r	
47N	53N	66N	55N	39N	
7H	8H	8H	7H	8H	

DAY  
74

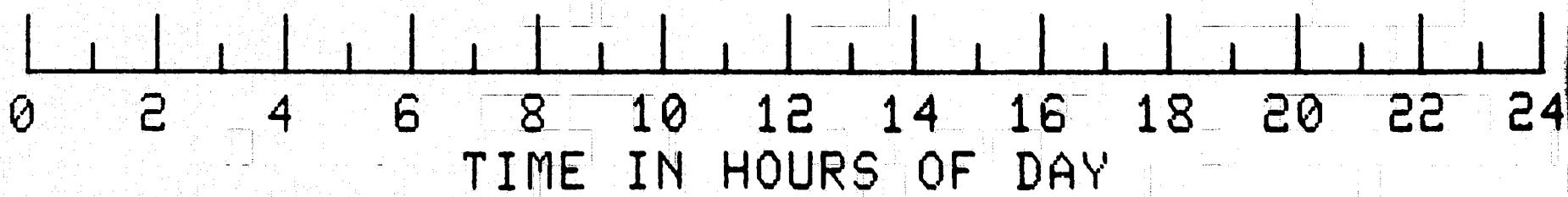
	S	P	
INP	SHE	SPH	
4r	1r	41S	57N
39N	37N	13H	1H
8H	8H	3H	3H
	46N		
	9H		

DAY  
75

	P	S	
SPH	SHE	INP	
57N	72N	1r	3r
3H	6H	58N	52N
	4H	4H	6H
	77N		
	3H		

DAY  
76

	INP				
3r	5r	7r	8r	8r	
52N	63N	73N	57N	47N	
6H	8H	7H	5H	6H	

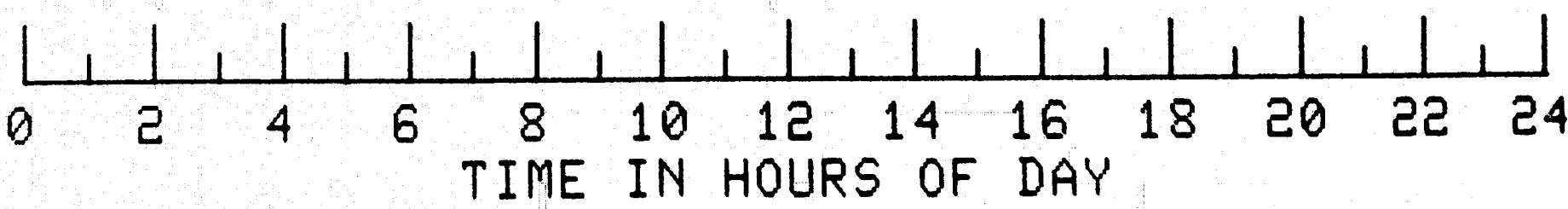


	INP			
DAY	8r 47N 7H	8r 55N 8H	7r 66N 7H	6r 52N 7H
				4r 39N 8H

	S	P	
	INP	SHE	SPH
DAY	3r 38N 8H	2r 37N 8H	1r 39N 9H
78			46N 9H

	P	S	
	SPH	SHE	INP
DAY	57N 3H	70N 5H	77N 4H
79			0r 1r 58N 4H

	INP			
DAY	3r 52N 6H	5r 63N 7H	7r 73N 6H	8r 56N 5H
				8r 47N 7H



## INP

DAY 81

8r 47N 7H	8r 55N 8H	7r 66N 7H	5r 52N 6H	4r 38N 7H
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S

P

DAY 82

INP 3r 38N 8H	SHE 2r 37N 8H	SPH 1r 39N 8H
	46N 9H	45N 9H
		30s 11H 22H 0H 3H

P

S

DAY 83

SPH 58N 3H	SHE 70N 5H	INP 77N 4H
		0r 59N 3H
		1r 52N 4H
		3r 6H

DAY 84

INP 3r 53N 6H	5r 64N 7H	7r 73N 6H	8r 56N 5H	8r 47N 6H
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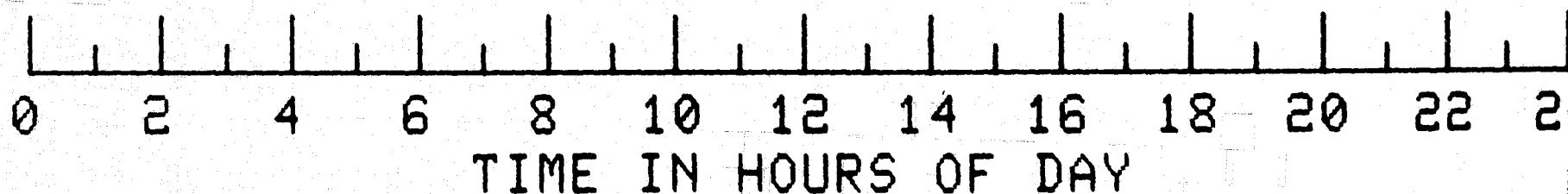
TIME IN HOURS OF DAY

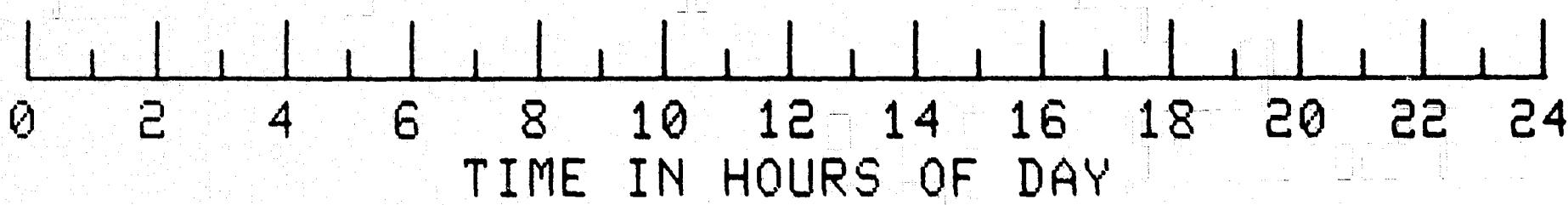
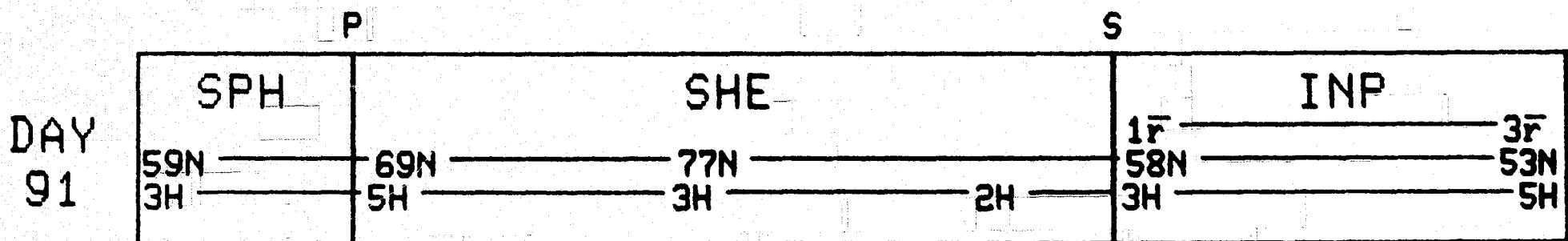
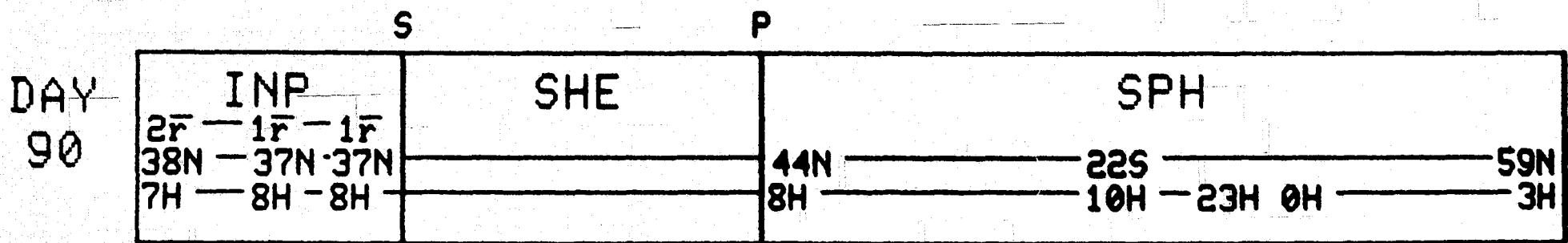
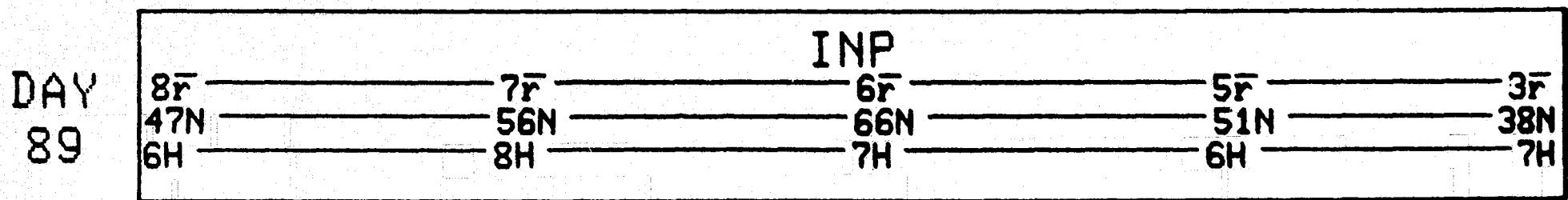
DAY 85	INP 8r 47N 7H	SHE 8r 55N 8H	SPH 7r 66N 7H	INP 5r 51N 6H	SPH 3r 38N 7H
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	S	P	SPH
DAY 86	INP 3r 38N 7H	SHE 2r 37N 8H	SPH 1r 45N 9H

	P	S	INP
DAY 87	SPH 58N 3H	SHE 68N 5H	INP 0r 1r 59N 3H

DAY 88	INP 3r 53N 6H	5r 64N 7H	6r 73N 6H	7r 56N 4H	8r 47M 5H
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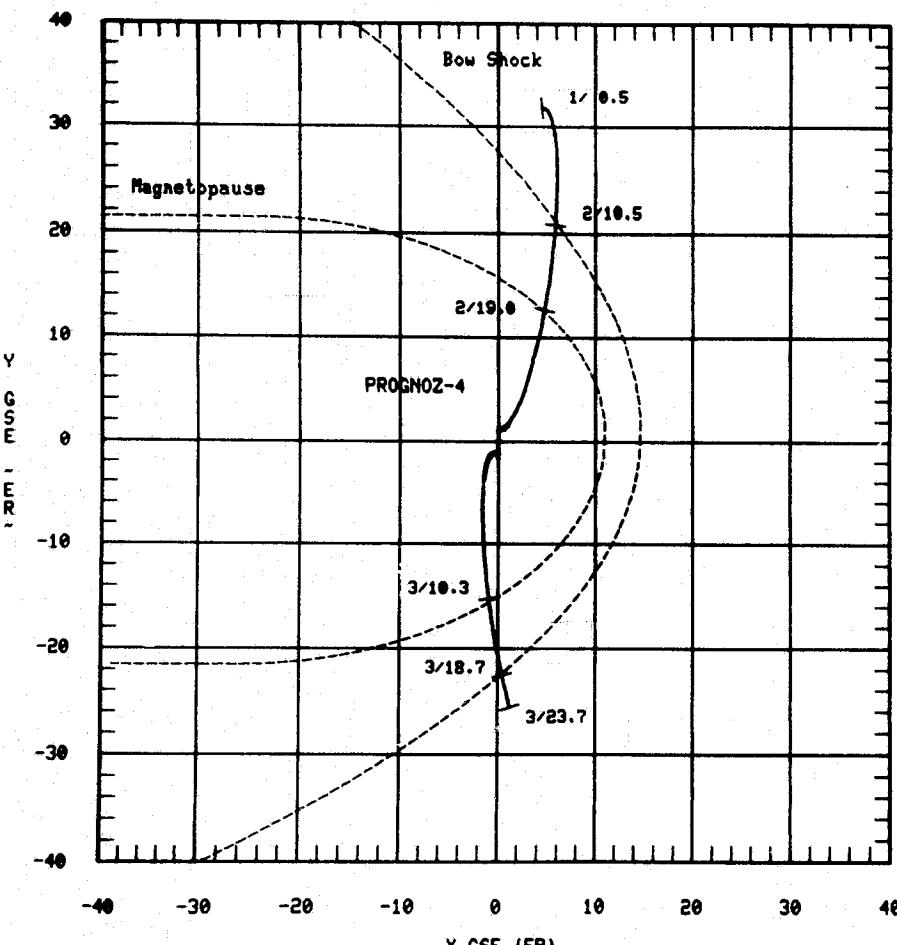




## **APPENDIX B**

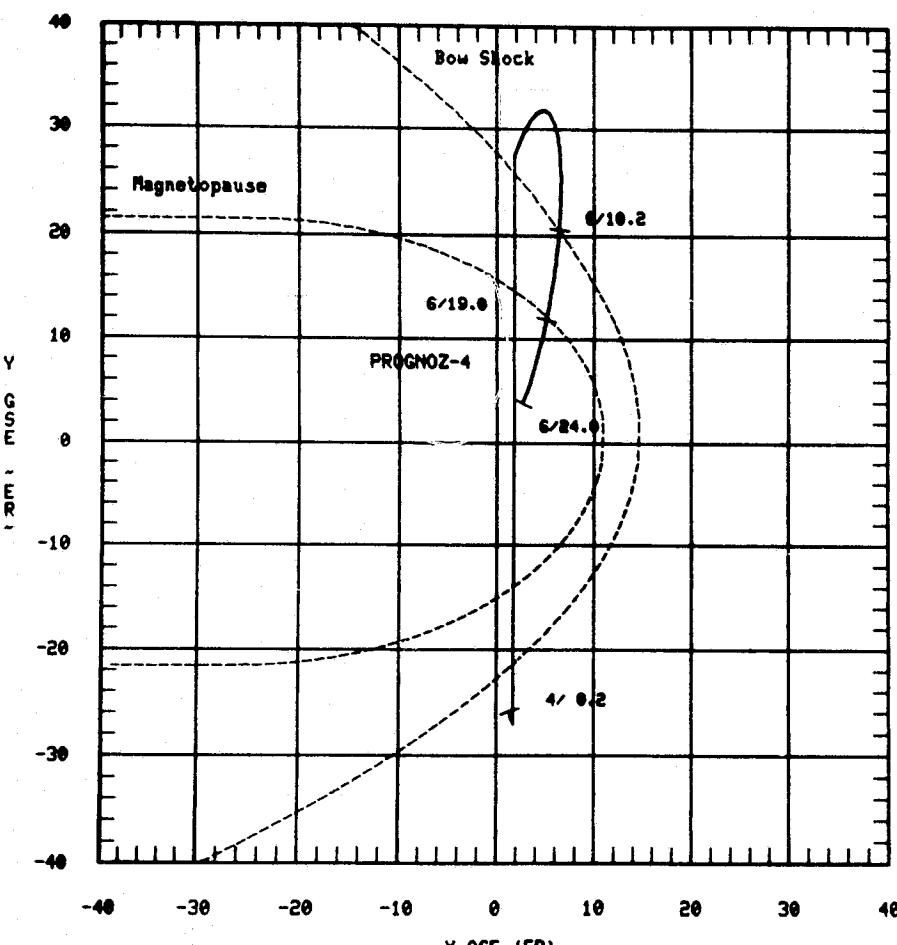
### **GEOCENTRIC SOLAR ECLIPTIC PLOTS**

GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



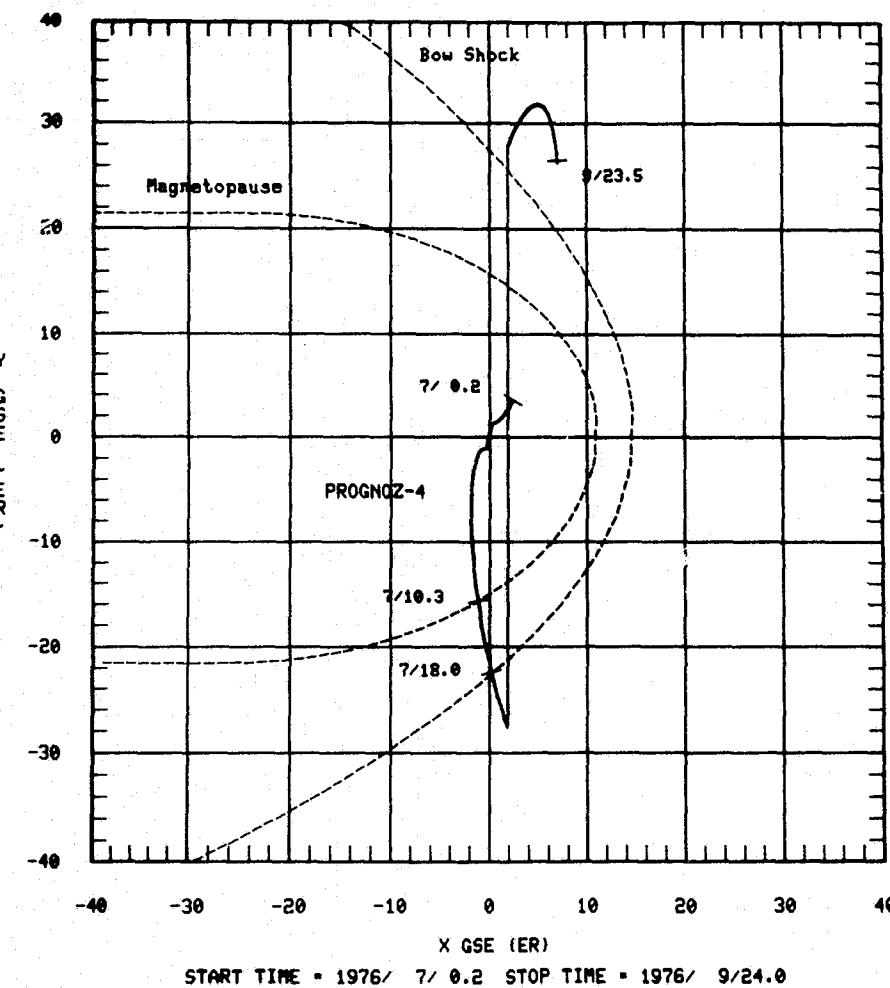
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GEOCENTRIC SOLAR ECLIPТИC X-Y PROJECTION

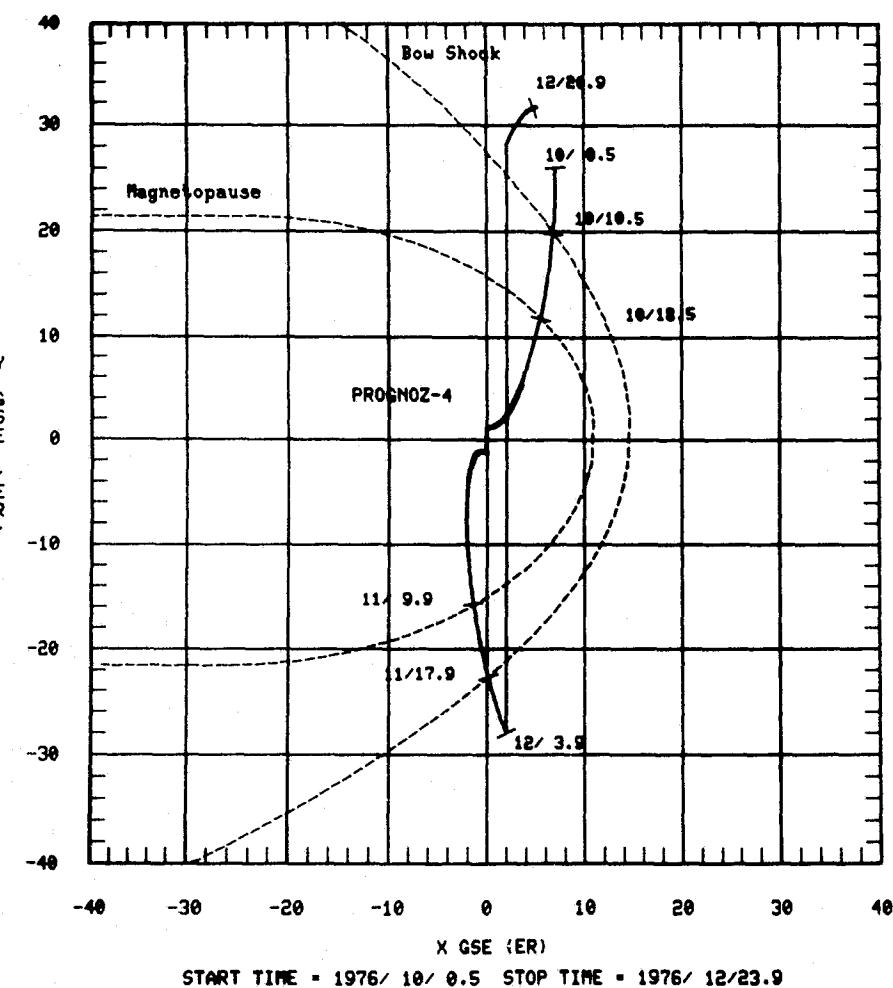


START TIME = 1976/ 4/ 0.2 STOP TIME = 1976/ 6/24.0

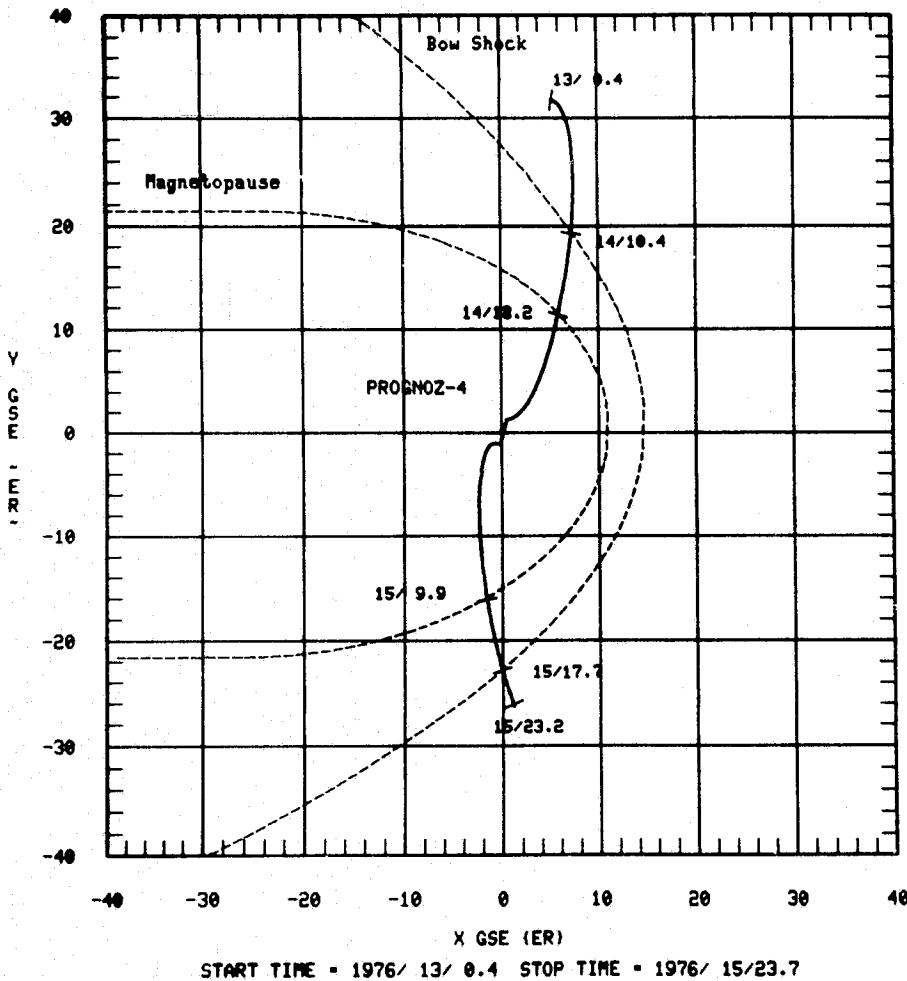
GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



GEOCENTRIC SOLAR ECLIPТИC X-Y PROJECTION

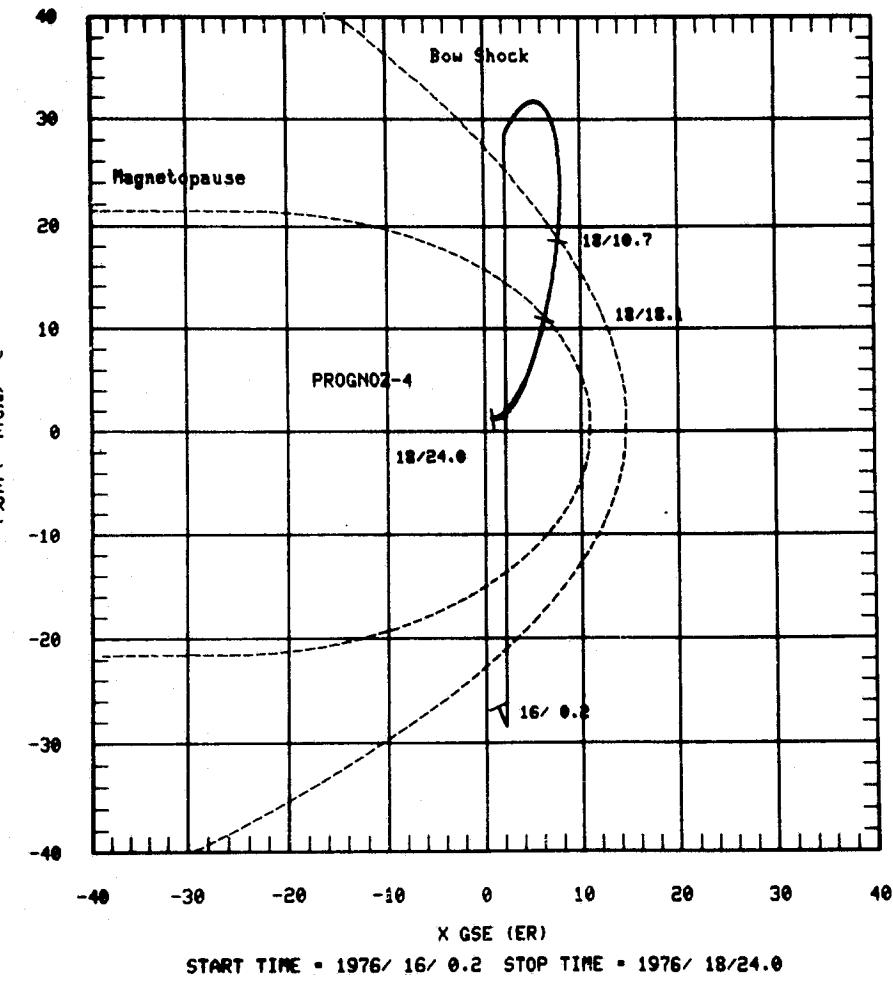


GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



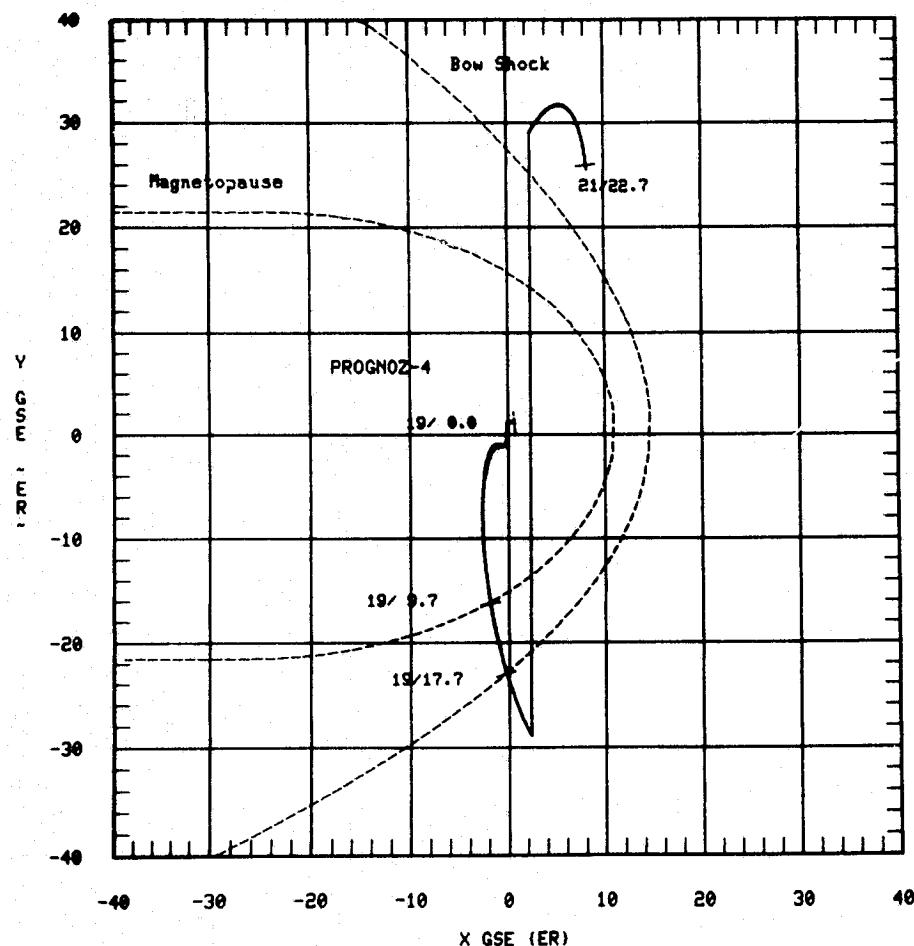
START TIME = 1976/ 13/ 0.4 STOP TIME = 1976/ 15/23.7

GEOCENTRIC SOLAR ECLIPITIC X-Y PROJECTION



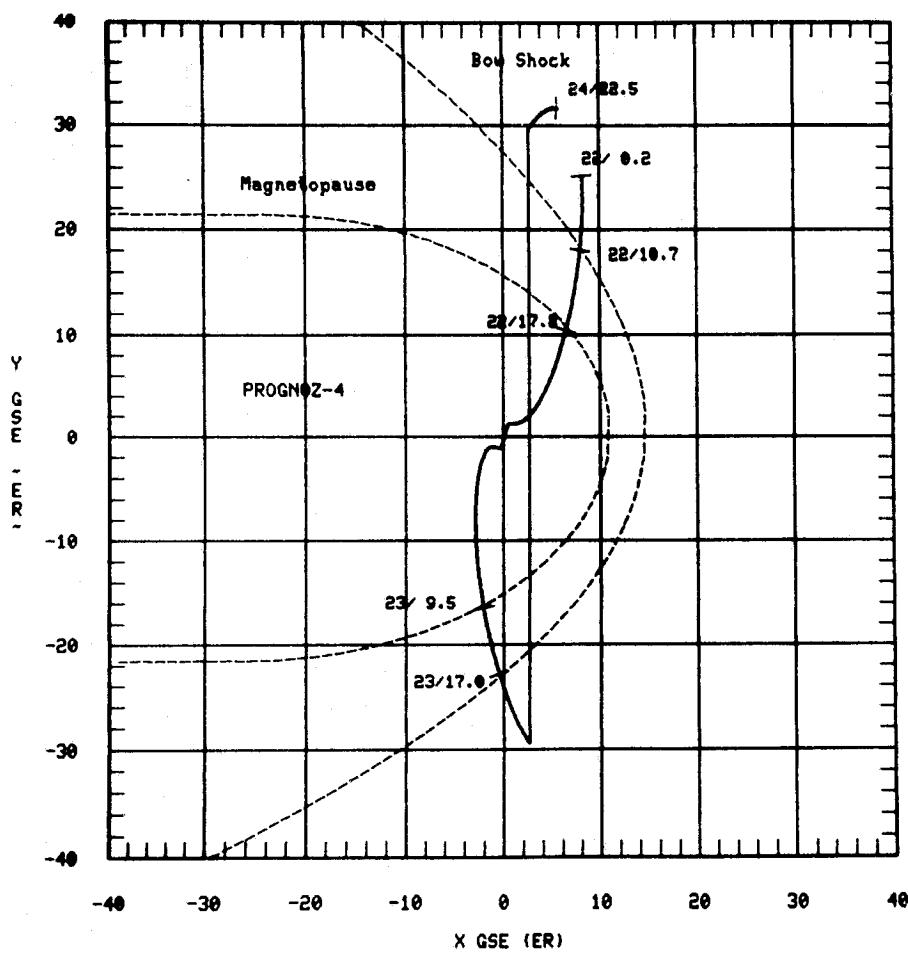
START TIME = 1976/ 16/ 0.2 STOP TIME = 1976/ 18/24.0

GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



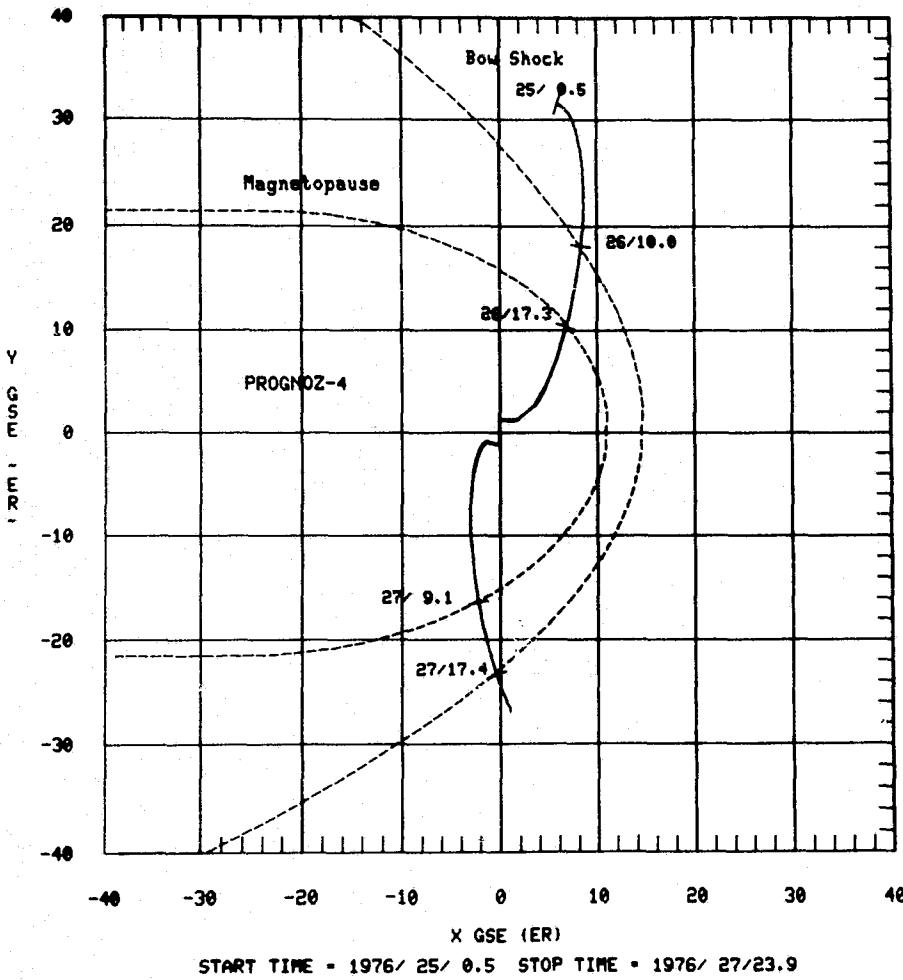
START TIME = 1976/ 19/ 0.0 STOP TIME = 1976/ 21/23.7

GEOCENTRIC SOLAR ECLIPtic X-Y PROJECTION

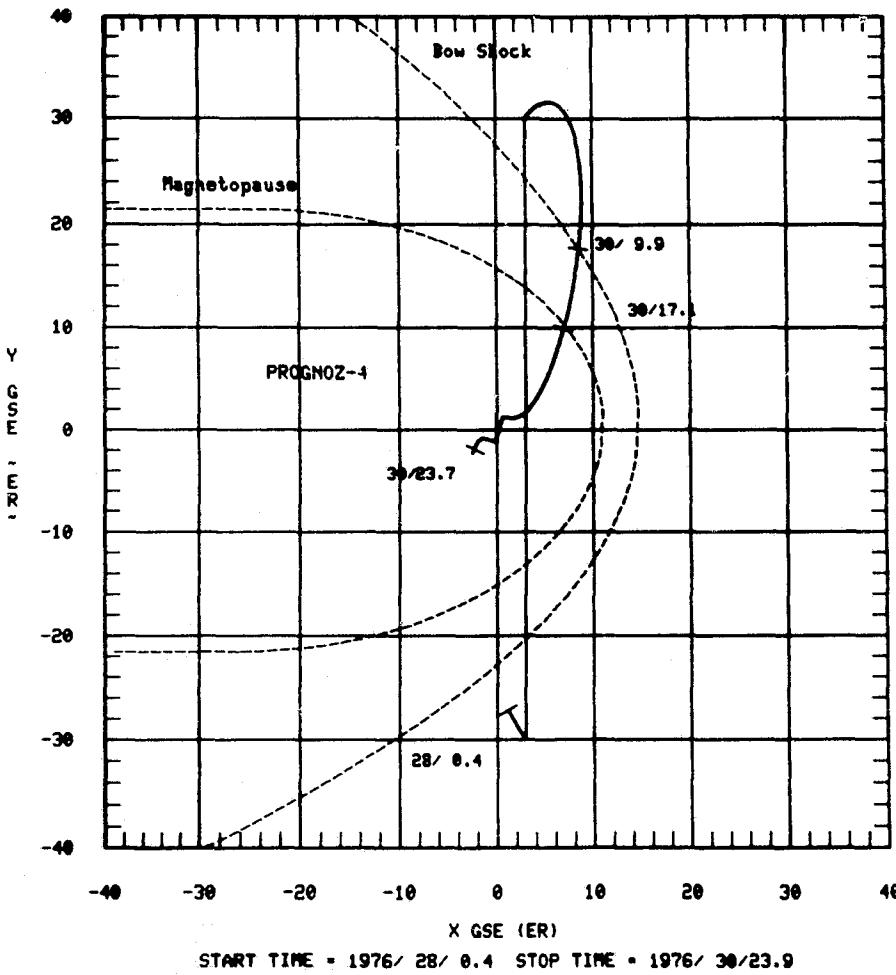


START TIME = 1976/ 22/ 0.2 STOP TIME = 1976/ 24/24.0

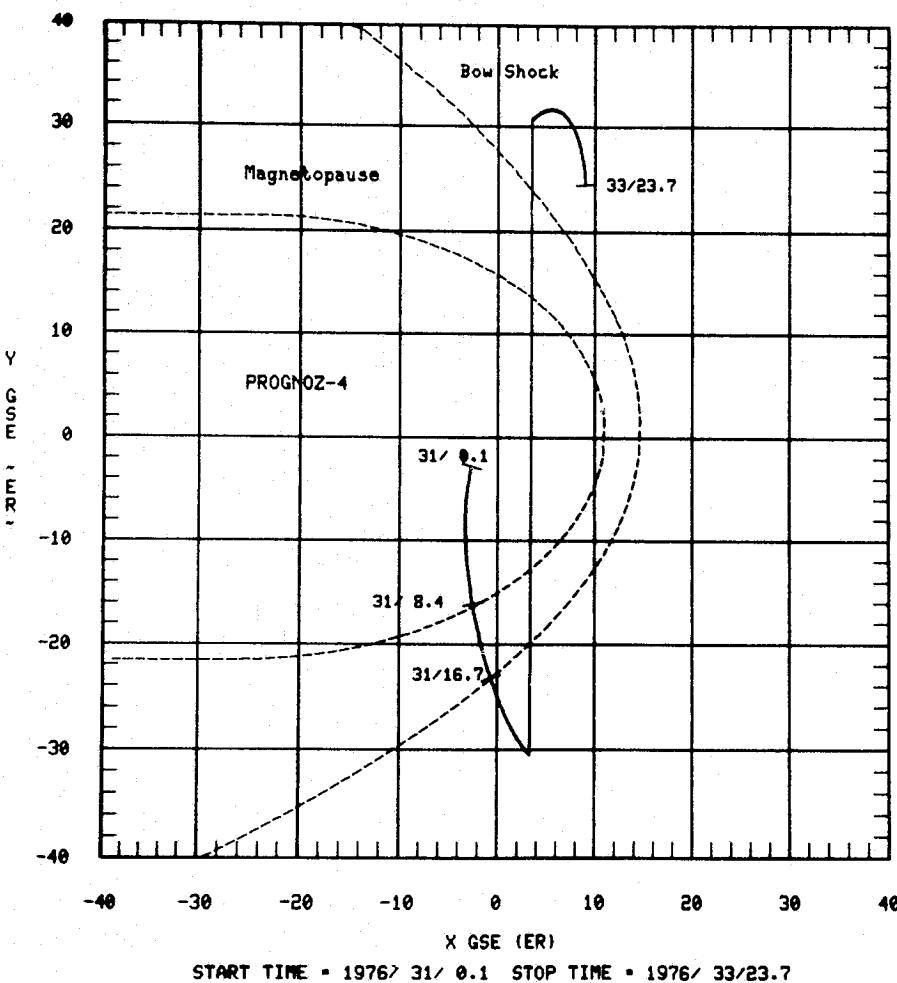
GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



GEOCENTRIC SOLAR ECLIPТИC X-Y PROJECTION

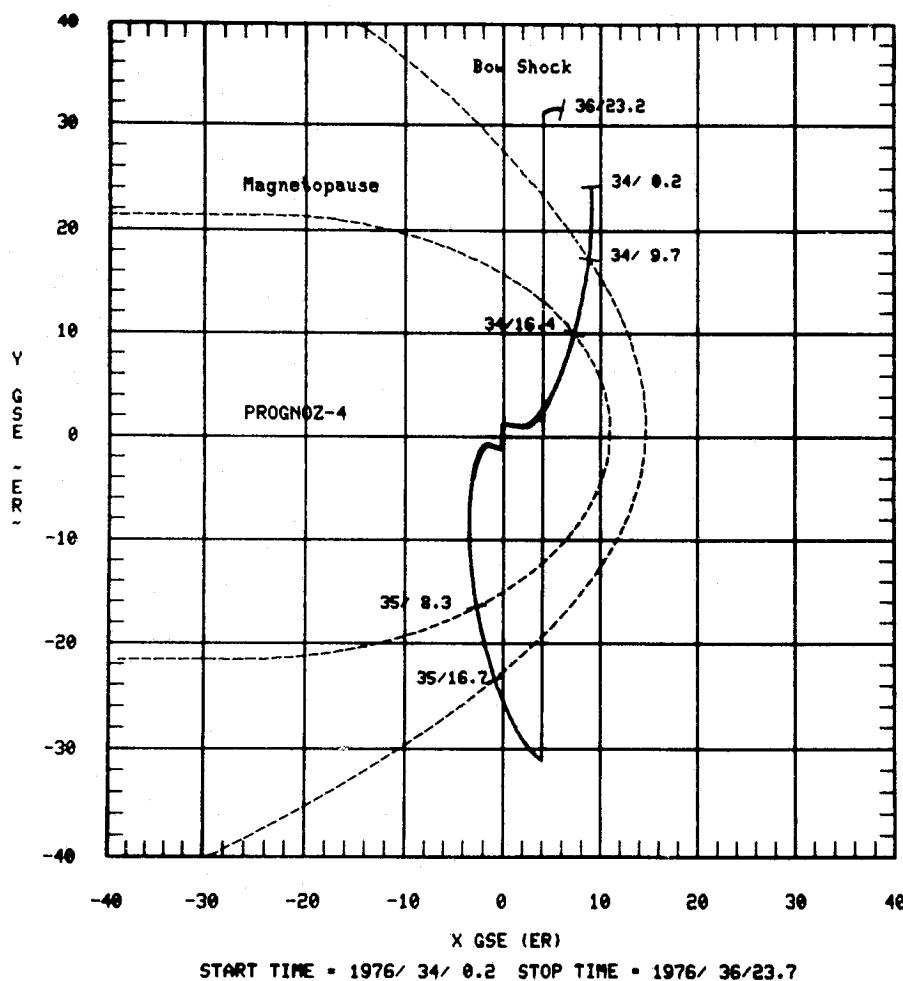


GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



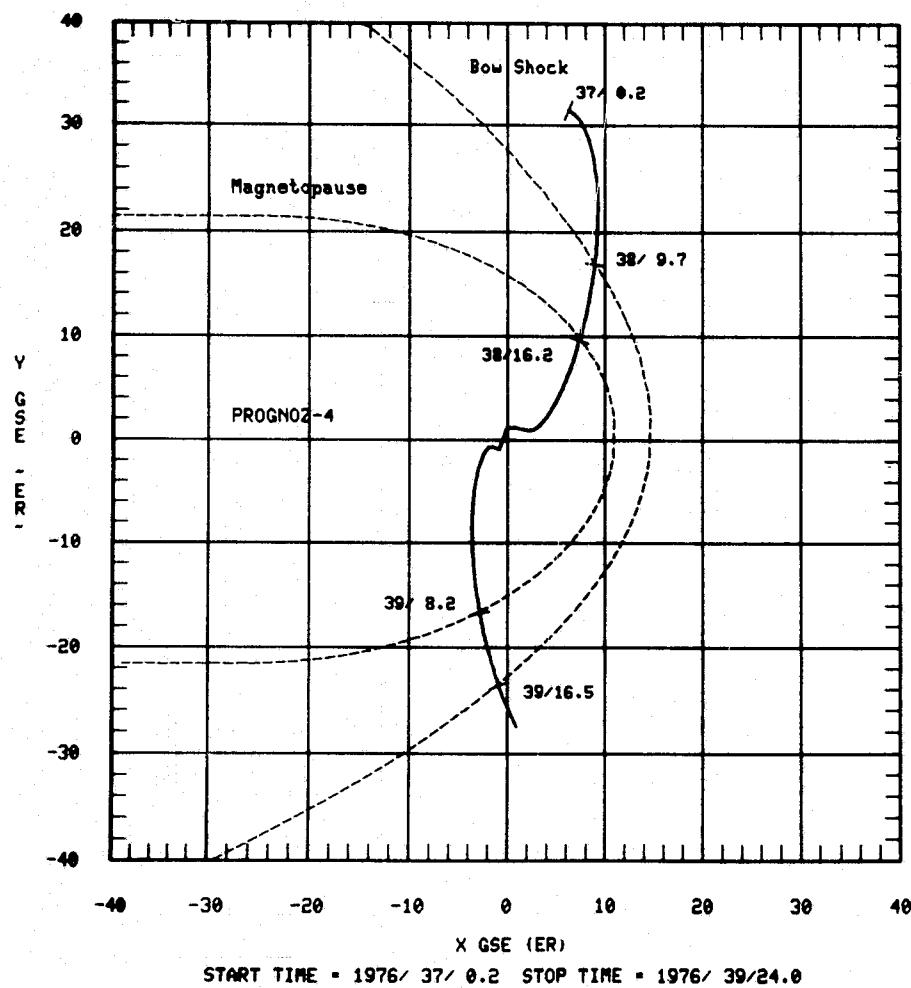
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GEOCENTRIC SOLAR ECLIPtic X-Y PROJECTION



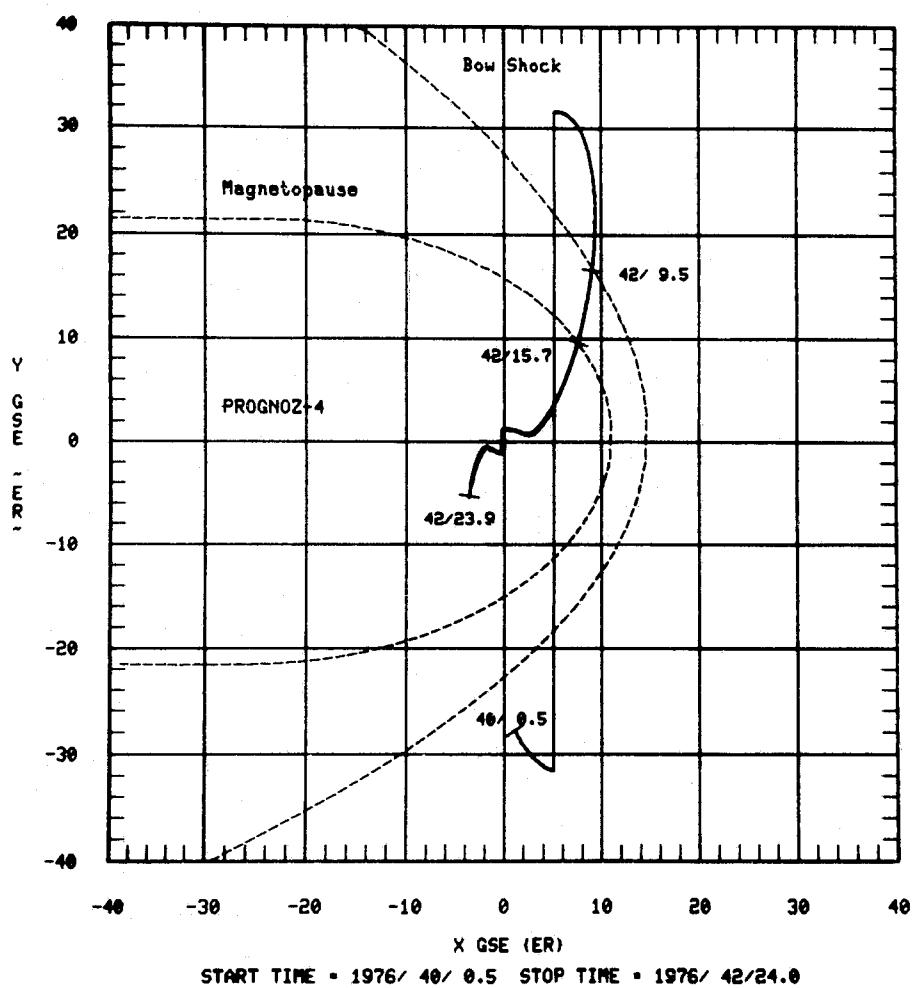
START TIME = 1976/ 34/ 0.2 STOP TIME = 1976/ 35/16.7

GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



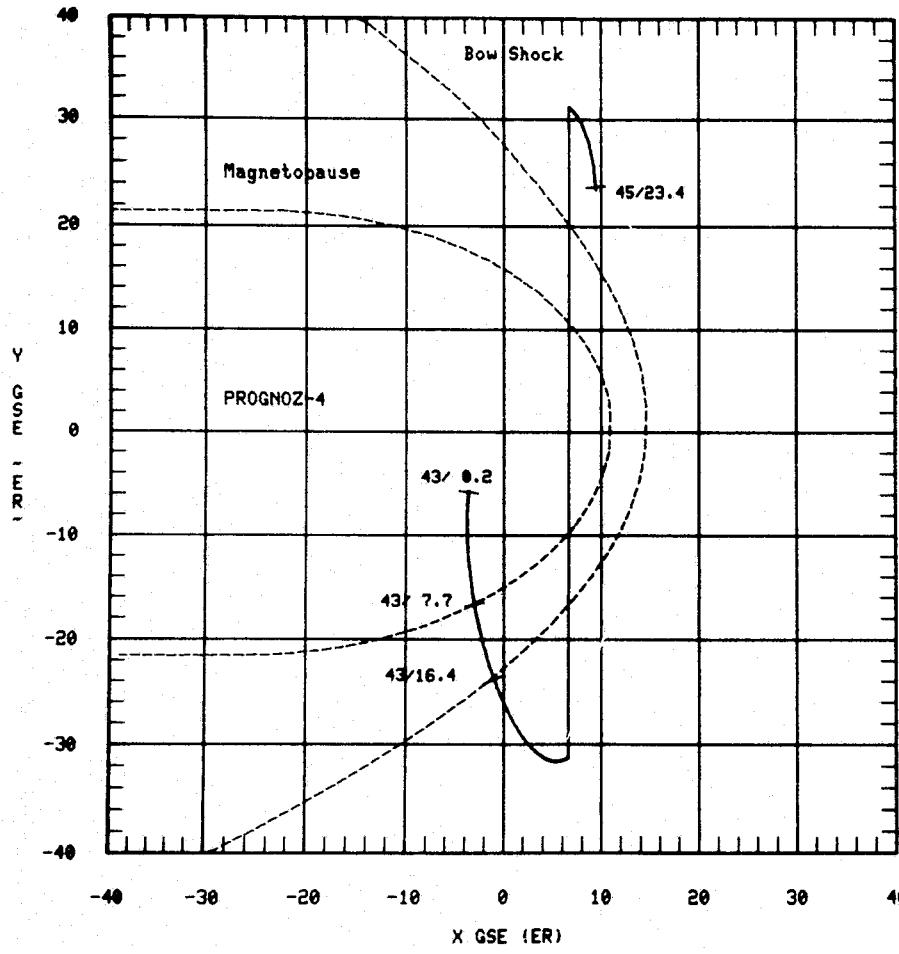
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GEOCENTRIC SOLAR ECLIPtic X-Y PROJECTION



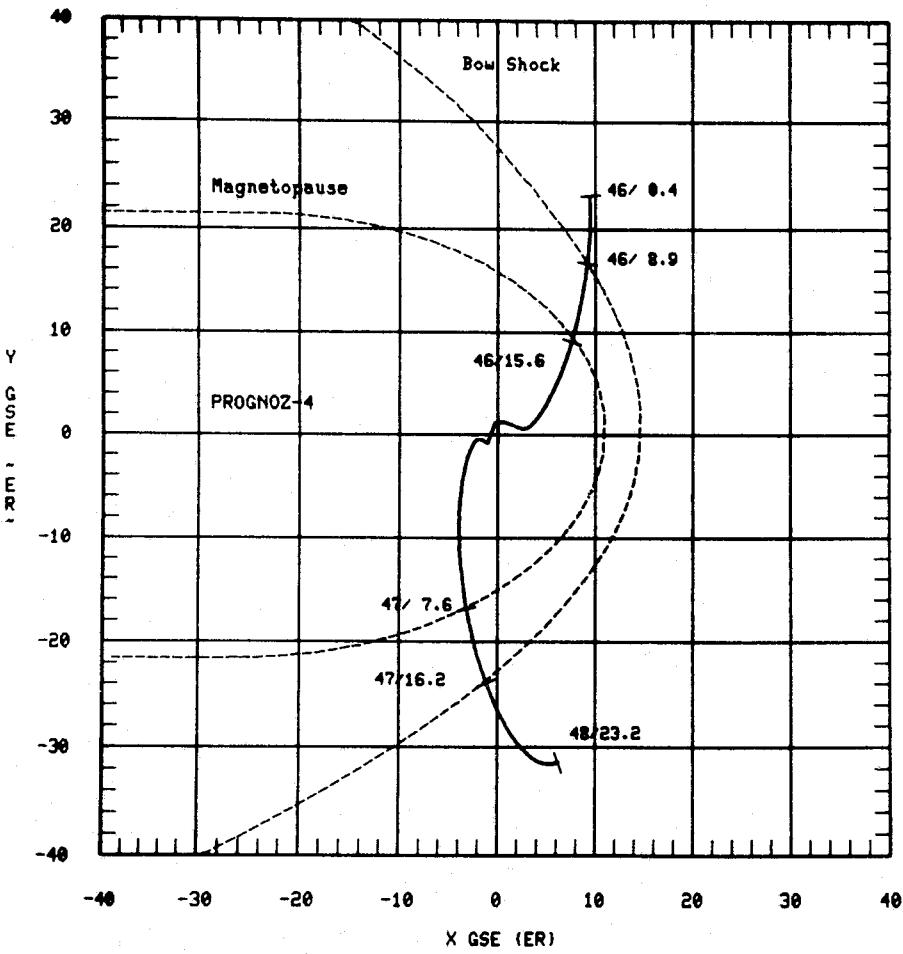
START TIME = 1976/ 40/ 0.5 STOP TIME = 1976/ 42/24.0

GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



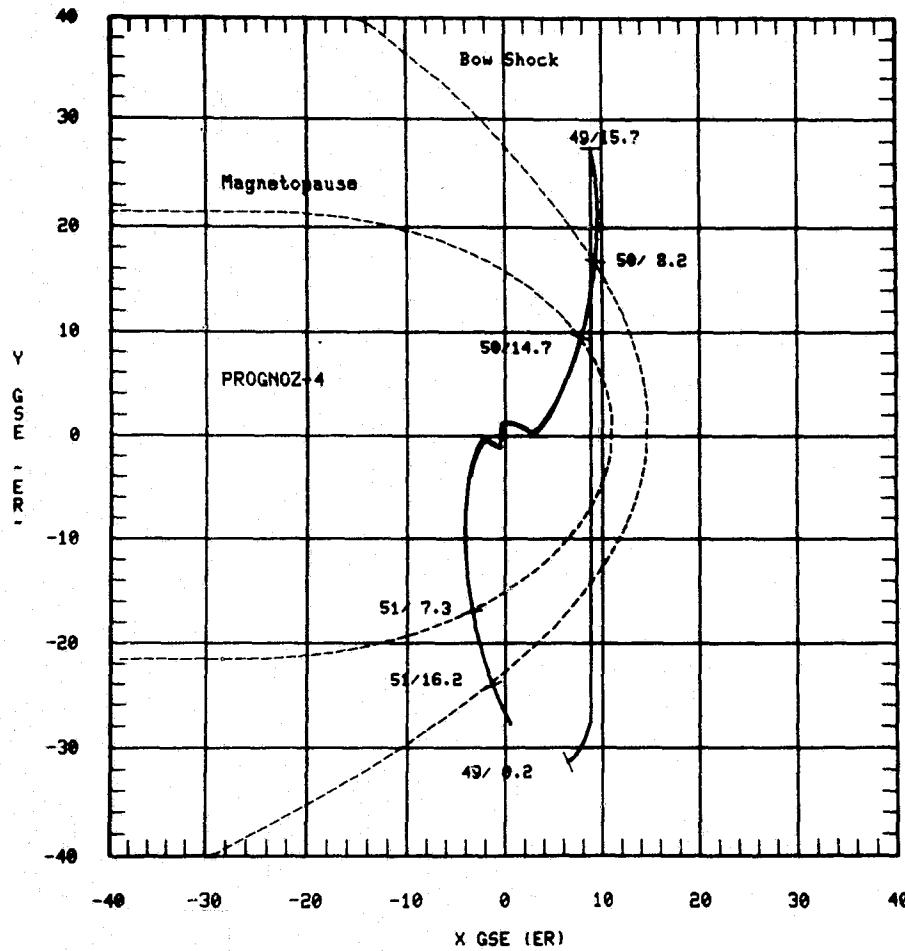
START TIME = 1976/ 43/ 0.1 STOP TIME = 1976/ 45/23.9

GEOCENTRIC SOLAR ECLIPТИC X-Y PROJECTION

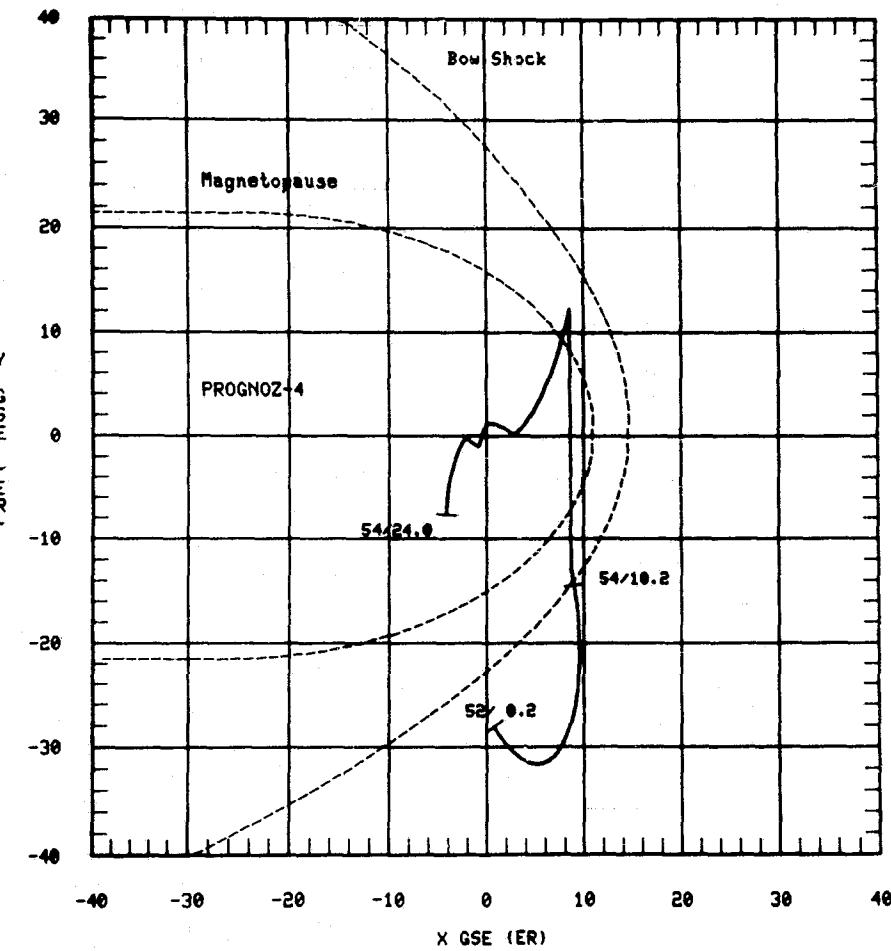


START TIME = 1976/ 46/ 0.4 STOP TIME = 1976/ 48/23.7

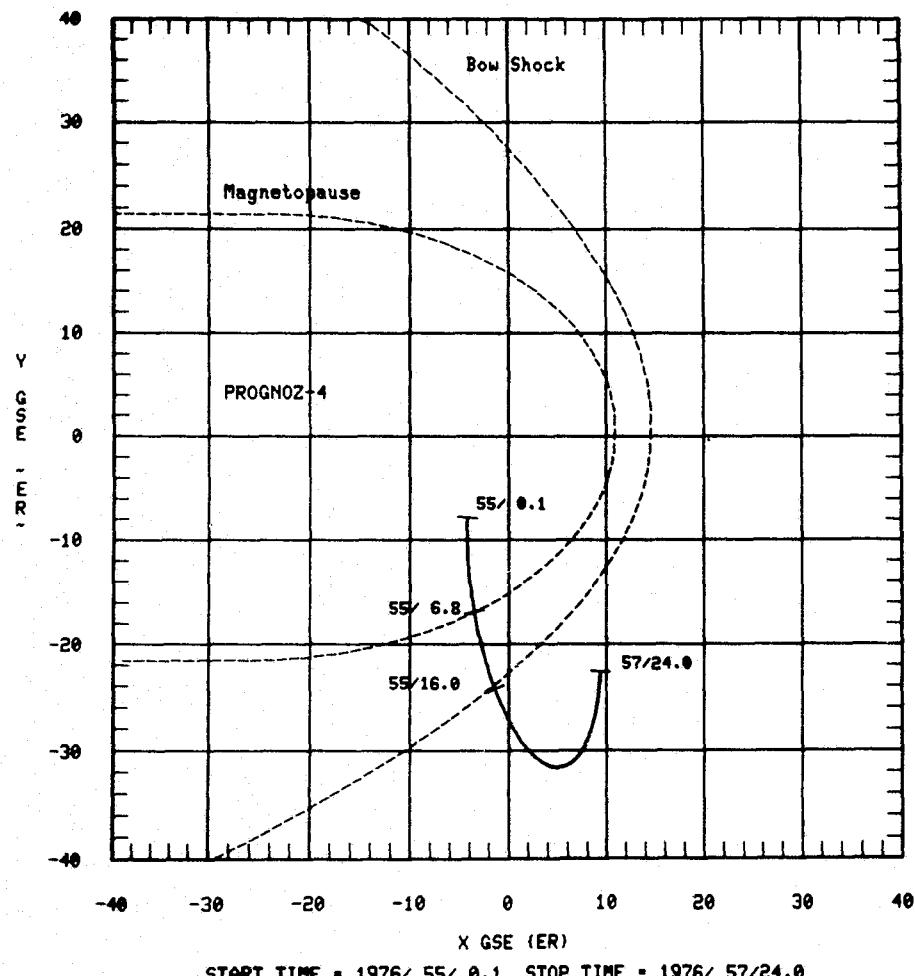
GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



GEOCENTRIC SOLAR ECLIPТИC X-Y PROJECTION

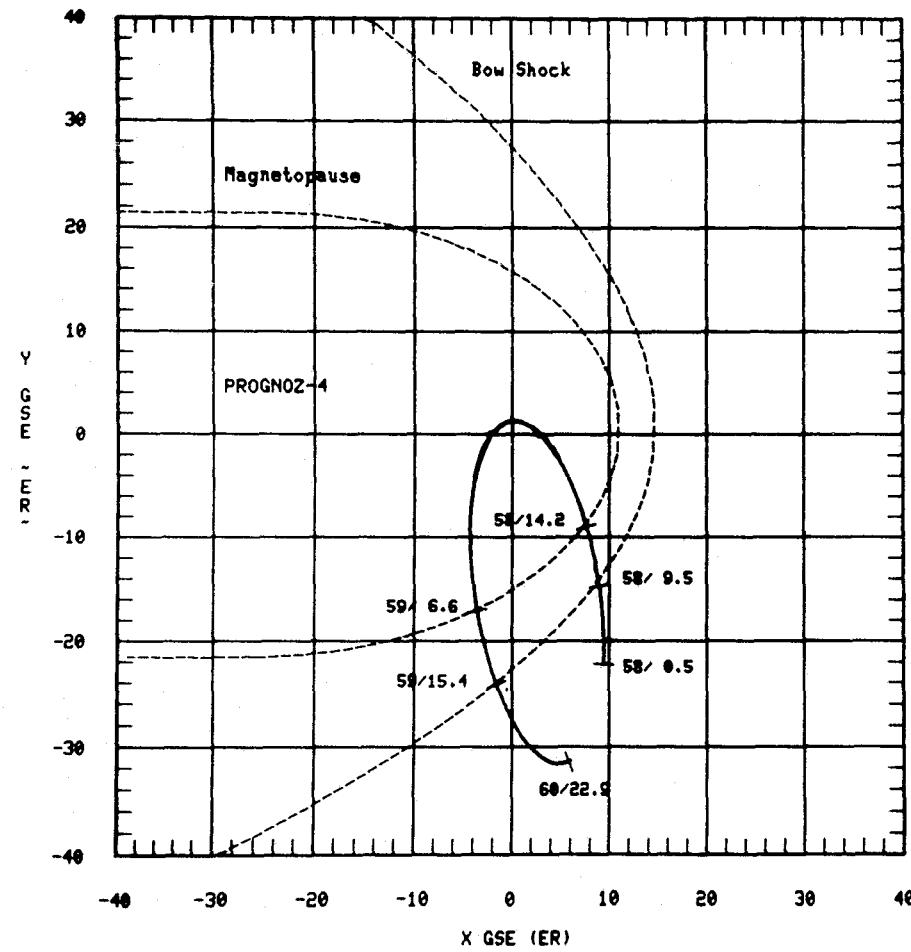


GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



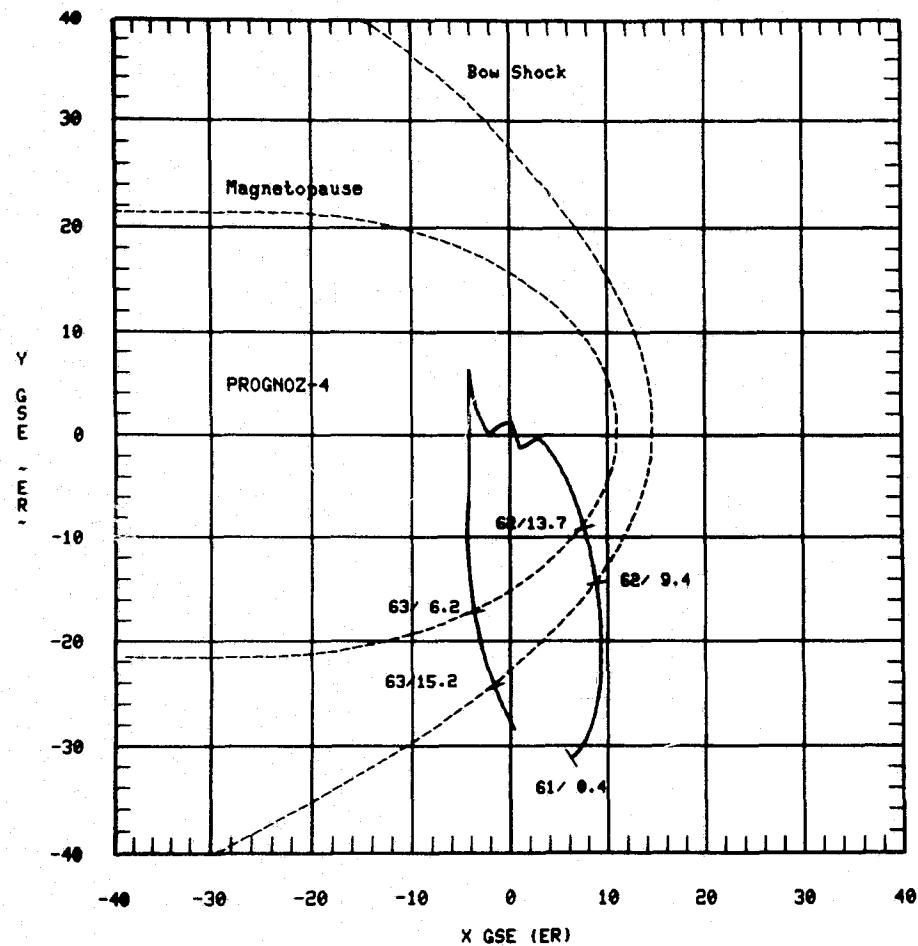
START TIME = 1976/ 55/ 0.1 STOP TIME = 1976/ 57/24.0

GEOCENTRIC SOLAR ECLIPtic X-Y PROJECTION



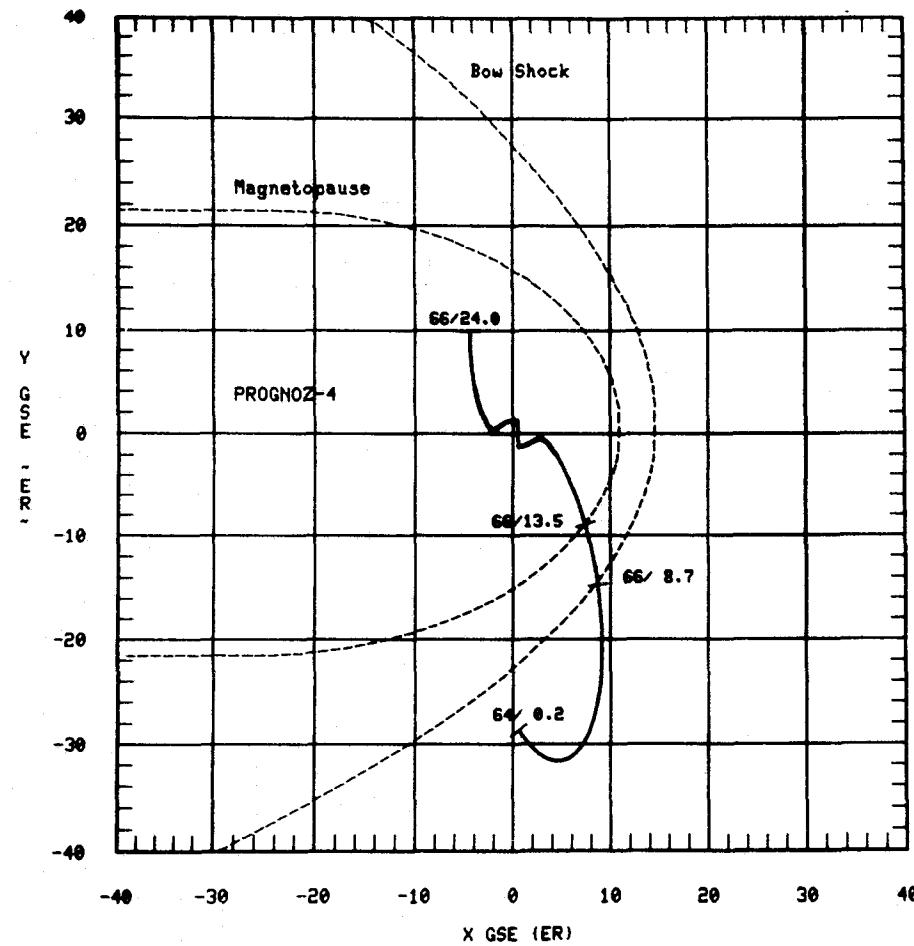
START TIME = 1976/ 58/ 0.5 STOP TIME = 1976/ 60/23.9

GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



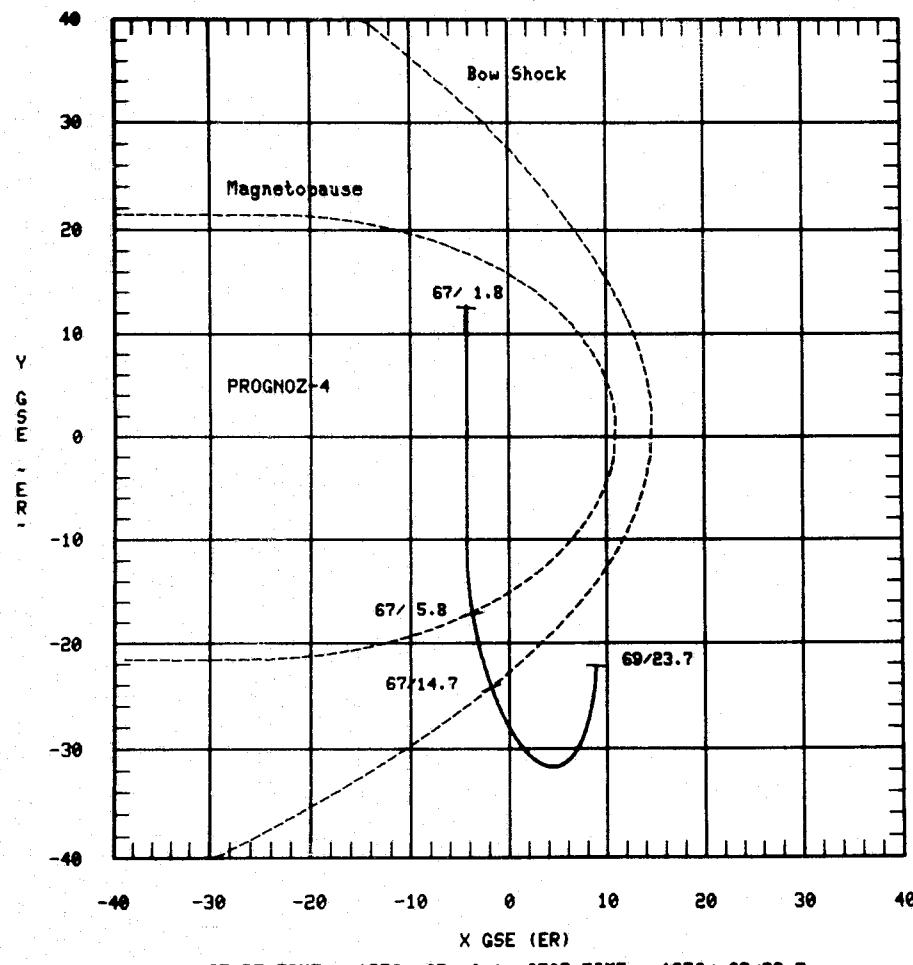
START TIME = 1976/ 61/ 0.4 STOP TIME = 1976/ 63/23.7

GEOCENTRIC SOLAR ECLIPSTIC X-Y PROJECTION



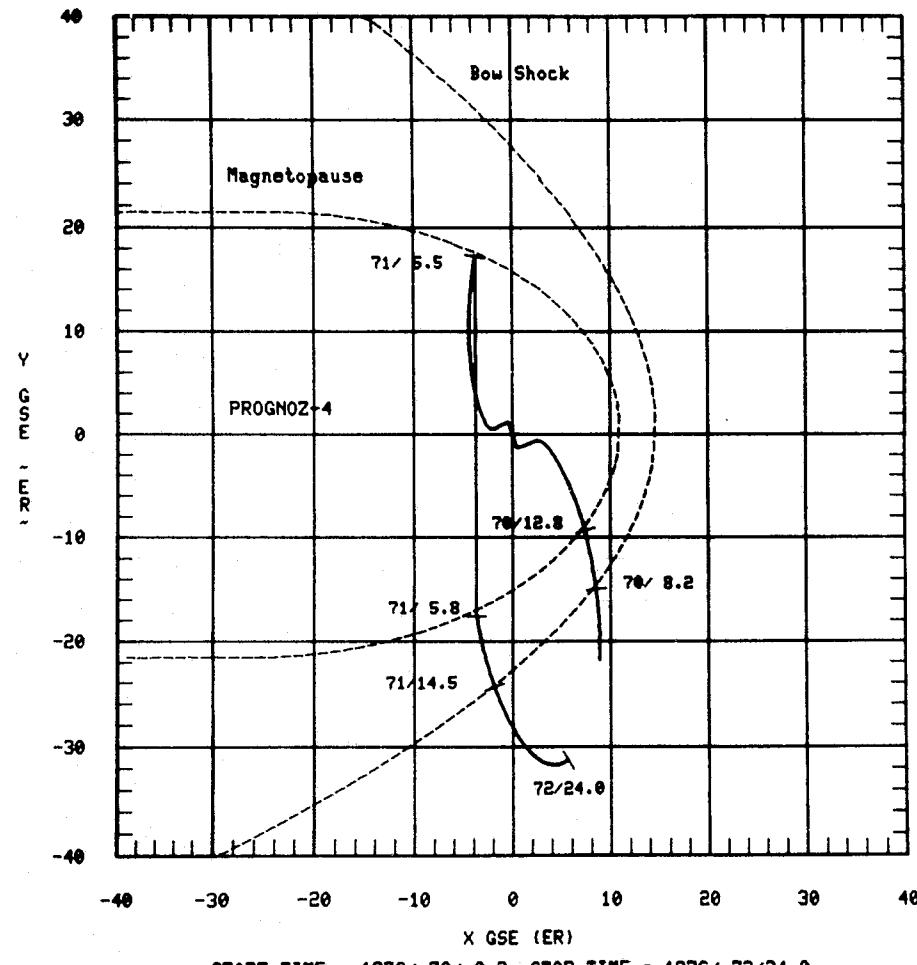
START TIME = 1976/ 64/ 0.2 STOP TIME = 1976/ 66/24.0

GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



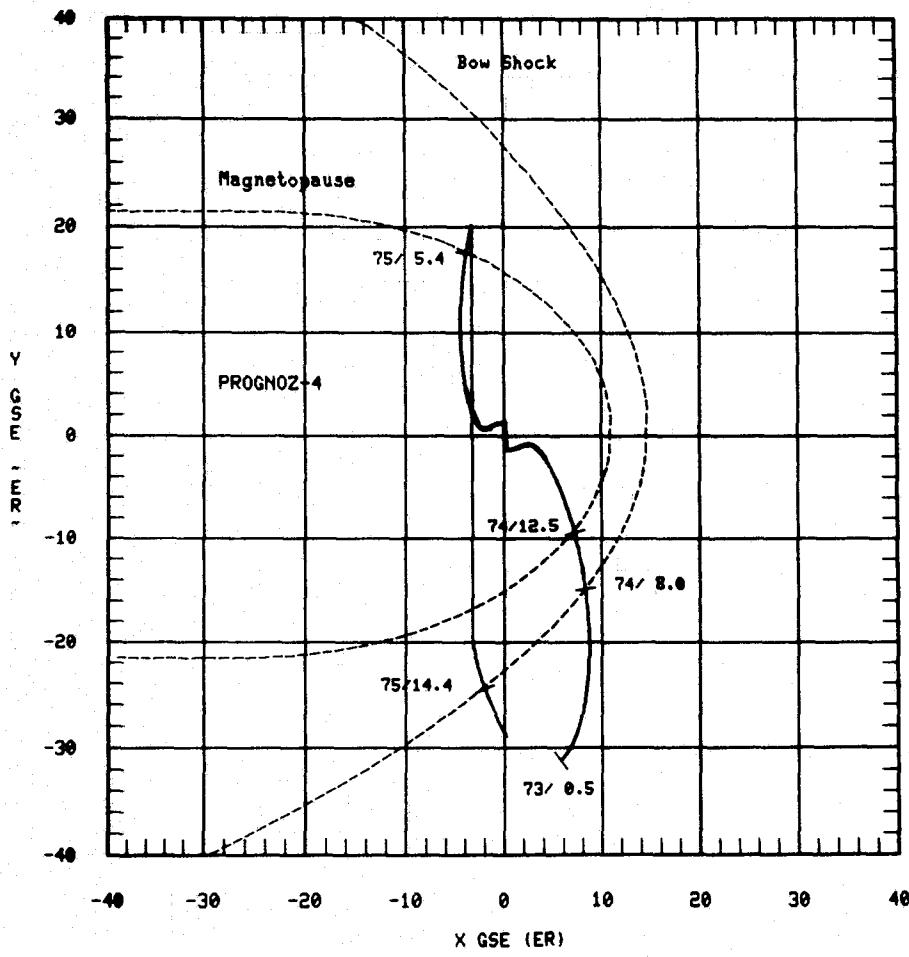
START TIME = 1976/ 67/ 0.1 STOP TIME = 1976/ 69/23.7

GEOCENTRIC SOLAR ECLIPТИC X-Y PROJECTION



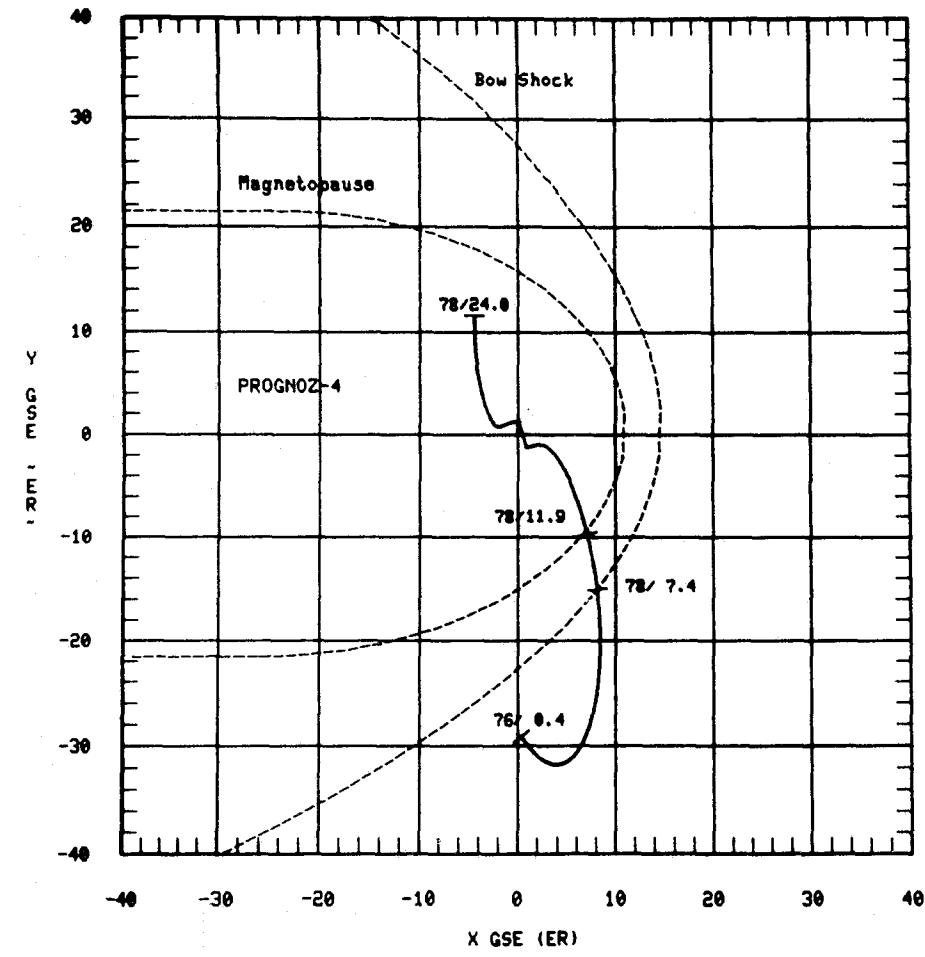
START TIME = 1976/ 70/ 0.2 STOP TIME = 1976/ 72/24.0

GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



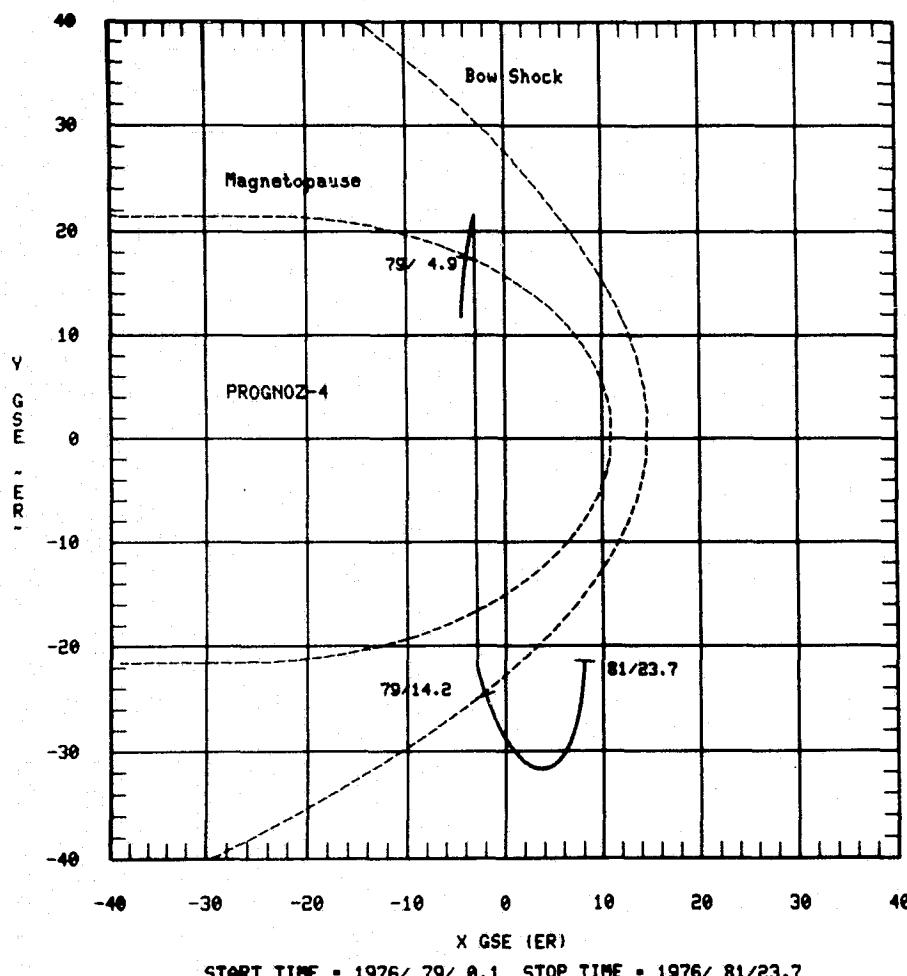
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GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



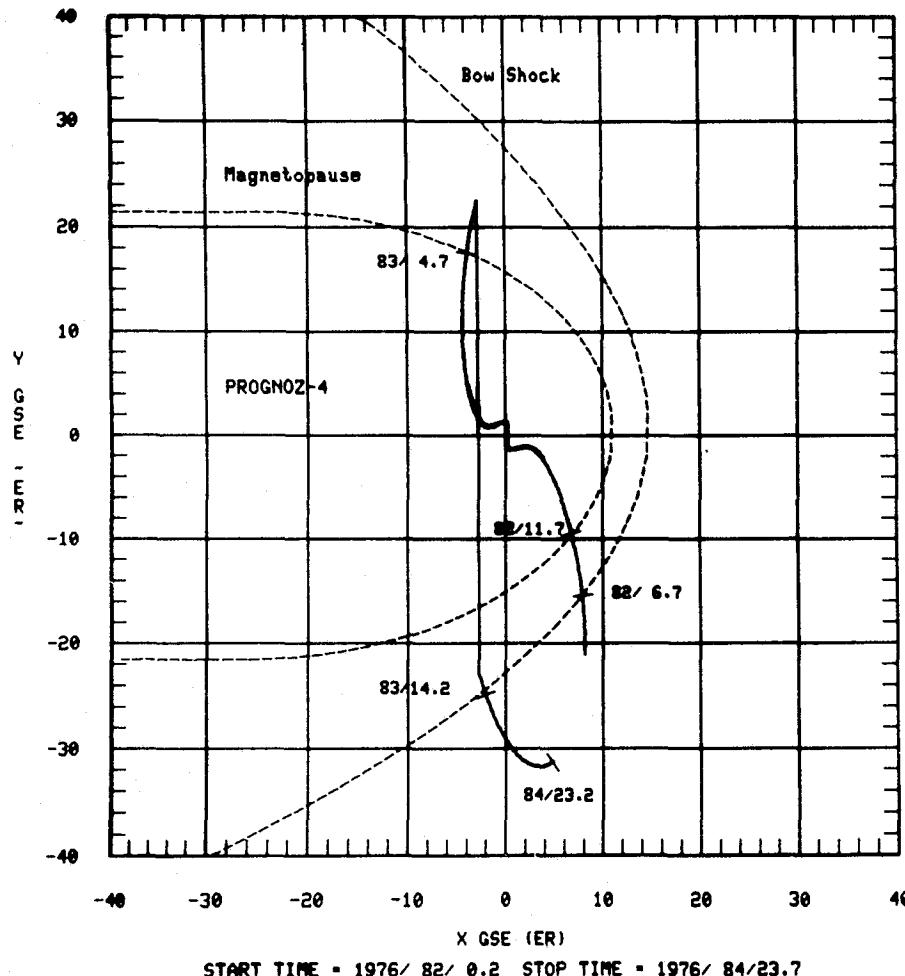
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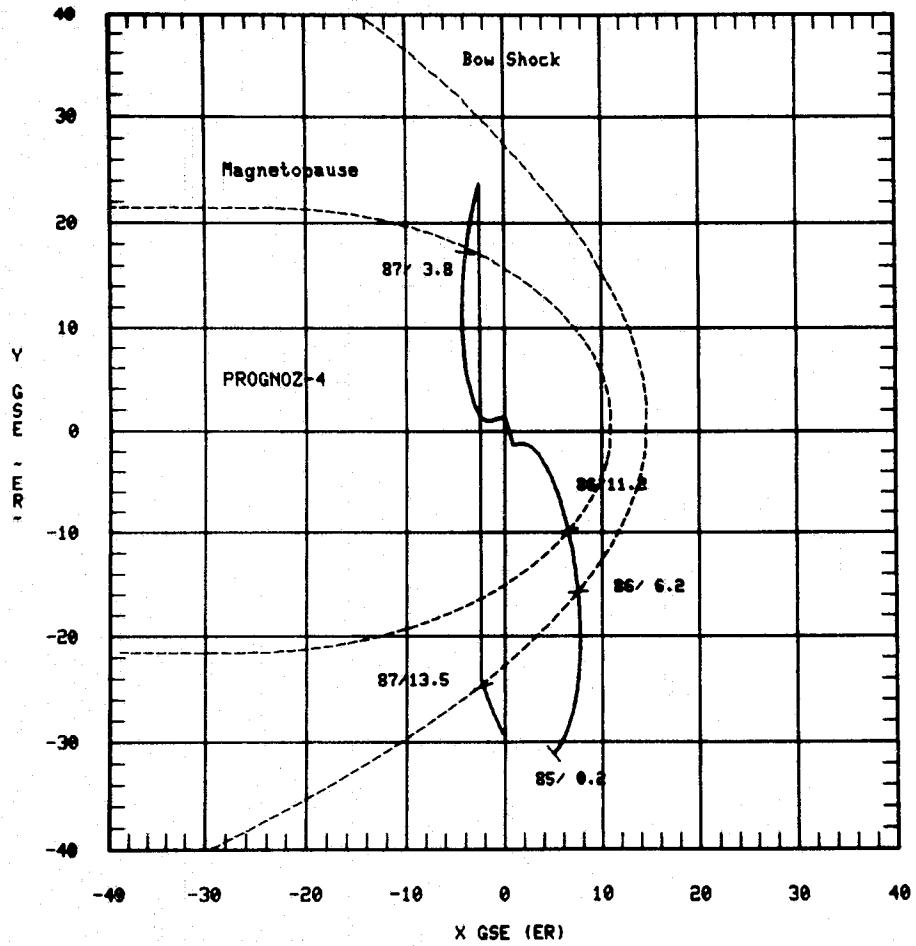
START TIME = 1976/ 79/ 0.1 STOP TIME = 1976/ 81/23.7

GEOCENTRIC SOLAR ECLIPSTIC X-Y PROJECTION



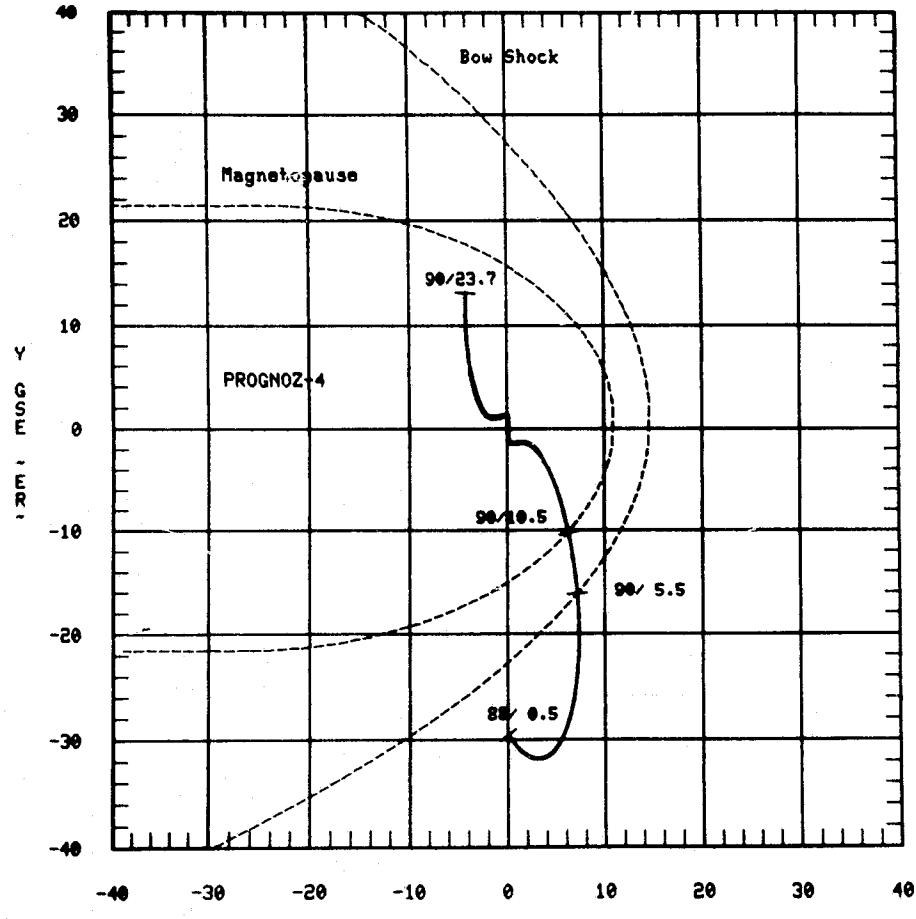
START TIME = 1976/ 82/ 0.2 STOP TIME = 1976/ 84/23.7

GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



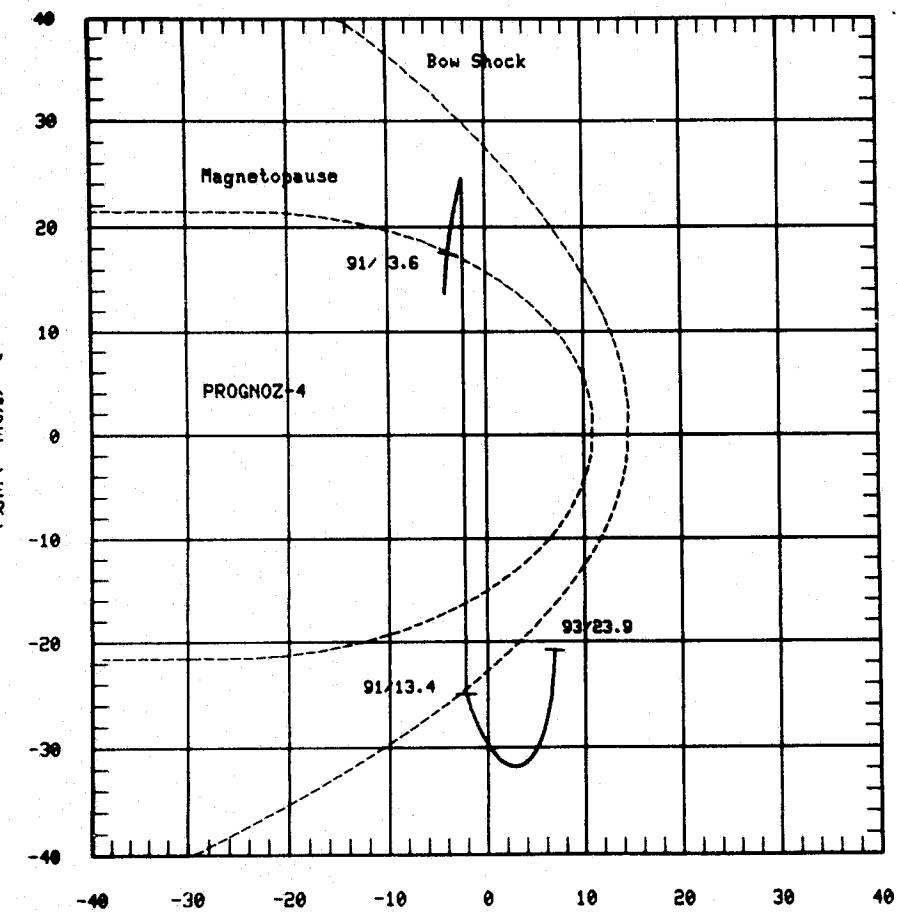
START TIME = 1976/ 85/ 0.2 STOP TIME = 1976/ 87/24.0

GEOCENTRIC SOLAR ECLIPITIC X-Y PROJECTION



START TIME = 1976/ 88/ 0.5 STOP TIME = 1976/ 90/23.9

GEOCENTRIC SOLAR ECLIPTIC X-Y PROJECTION



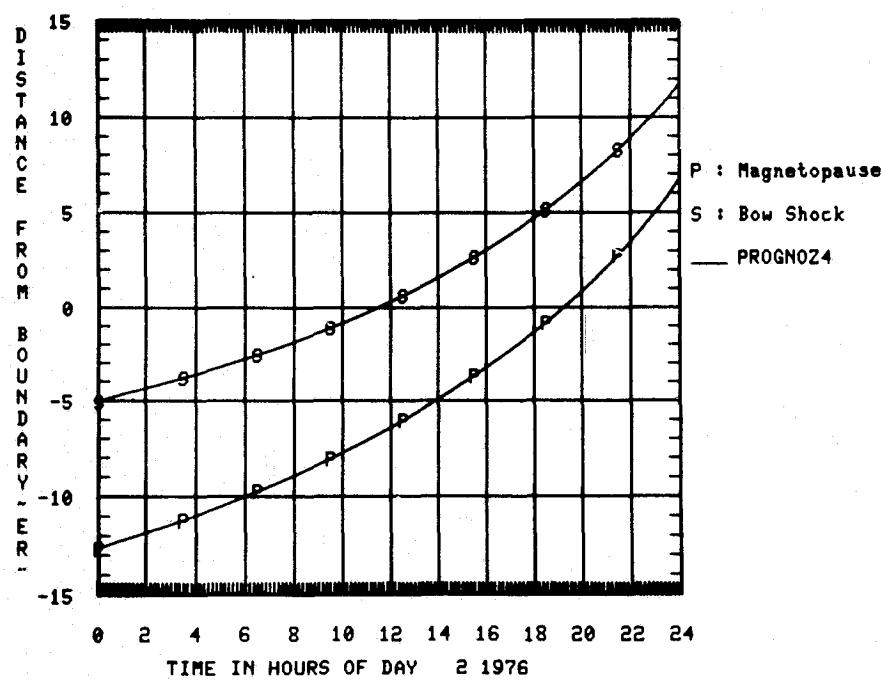
START TIME = 1976/ 91/ 0.1 STOP TIME = 1976/ 93/23.9

## **APPENDIX C**

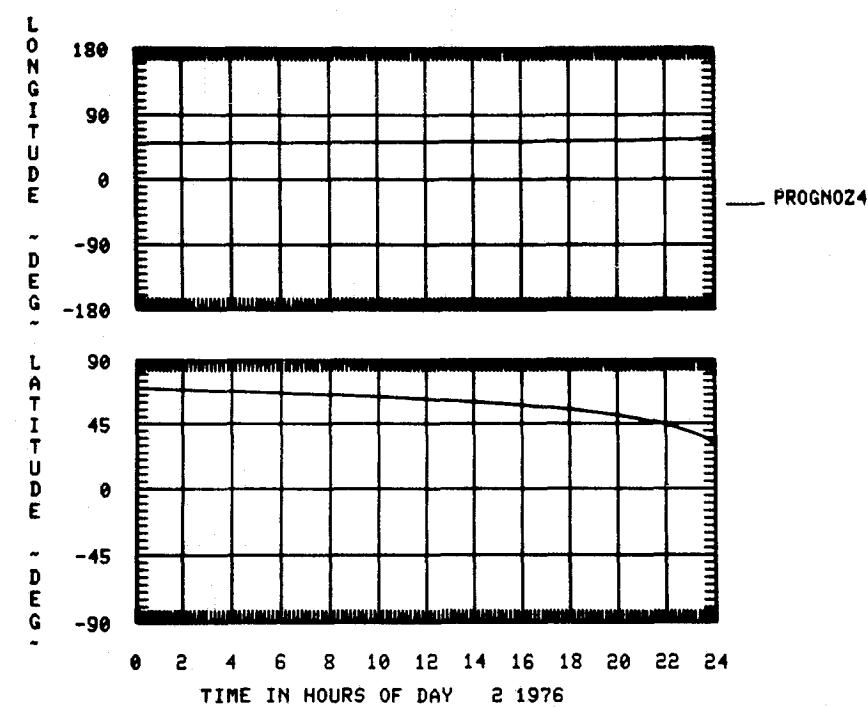
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**BOUNDARY PLOT**

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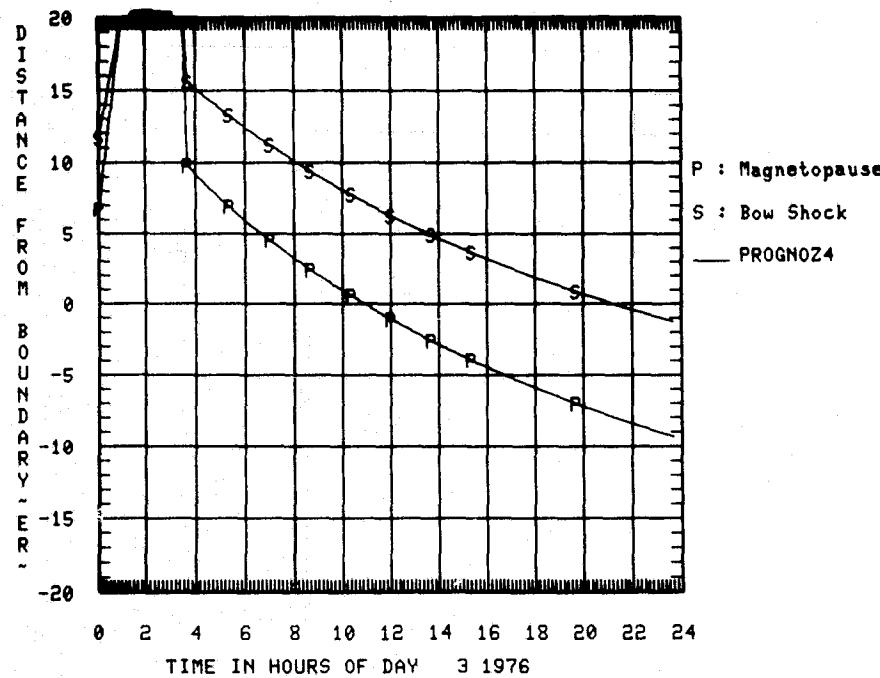


**BOUNDARY PLOT**  
SAT ID: PROGNOZ4  
ECLIPTIC POLAR COORDINATES



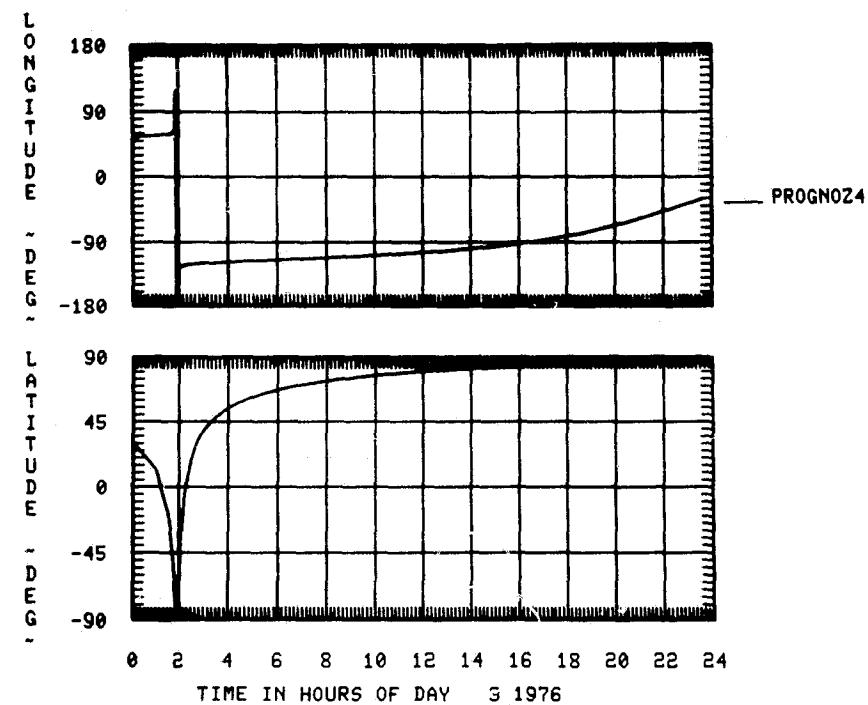
BOUNDARY PLOT

SAT ID: PROGNOZ4



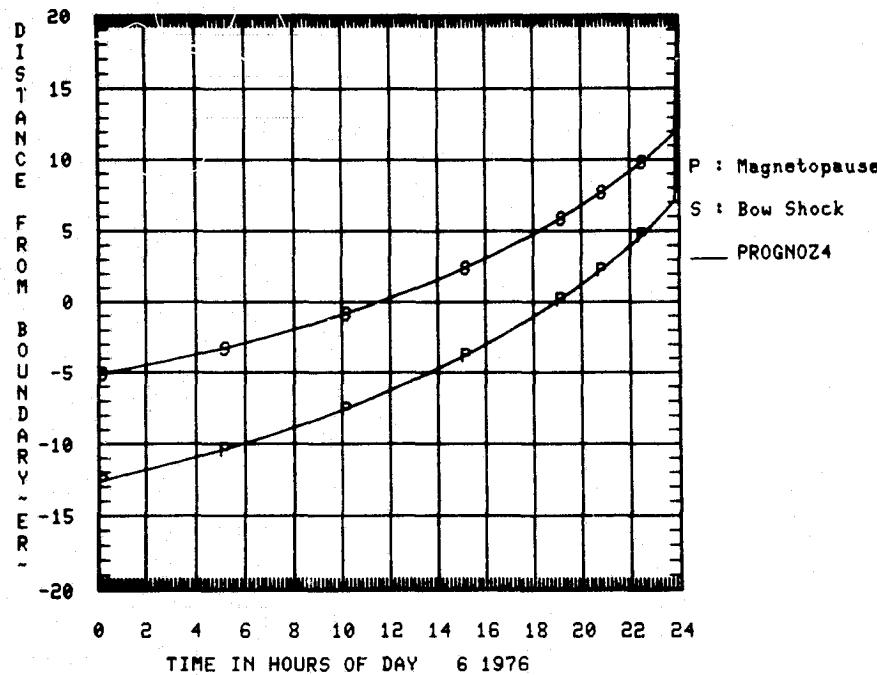
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SAT ID: PROGNOZ4  
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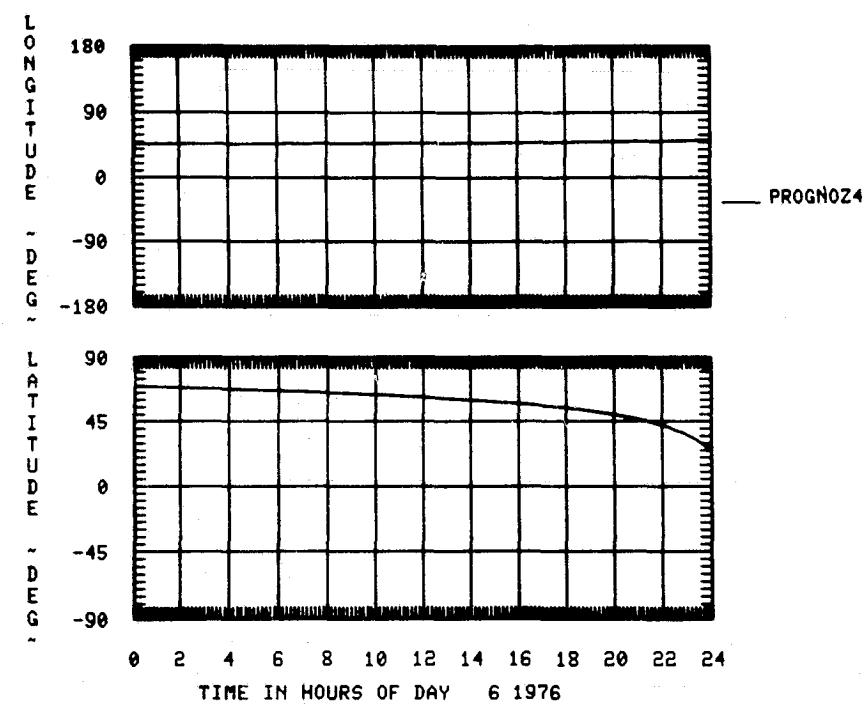
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SAT ID: PROGNO24



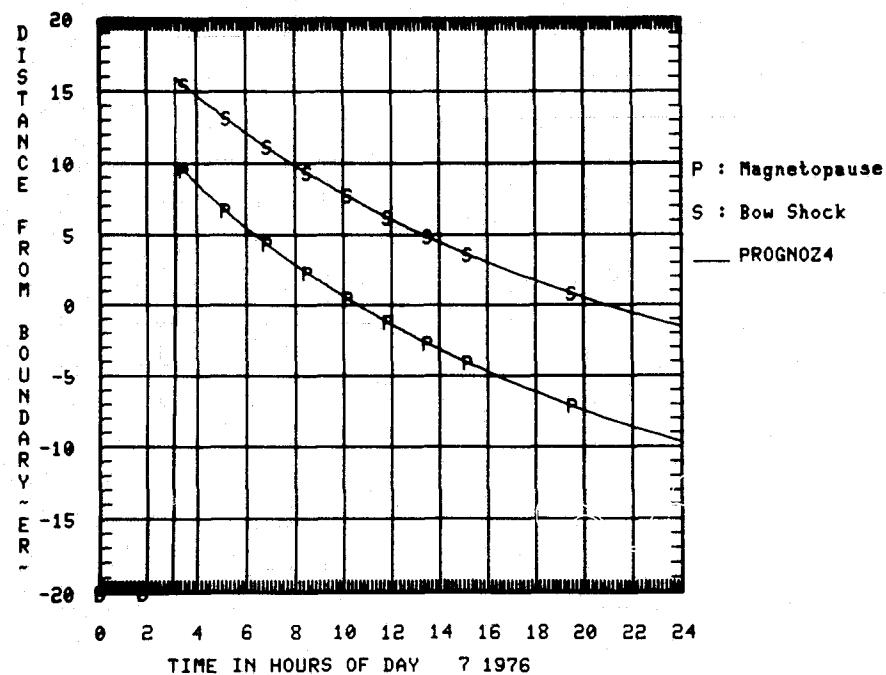
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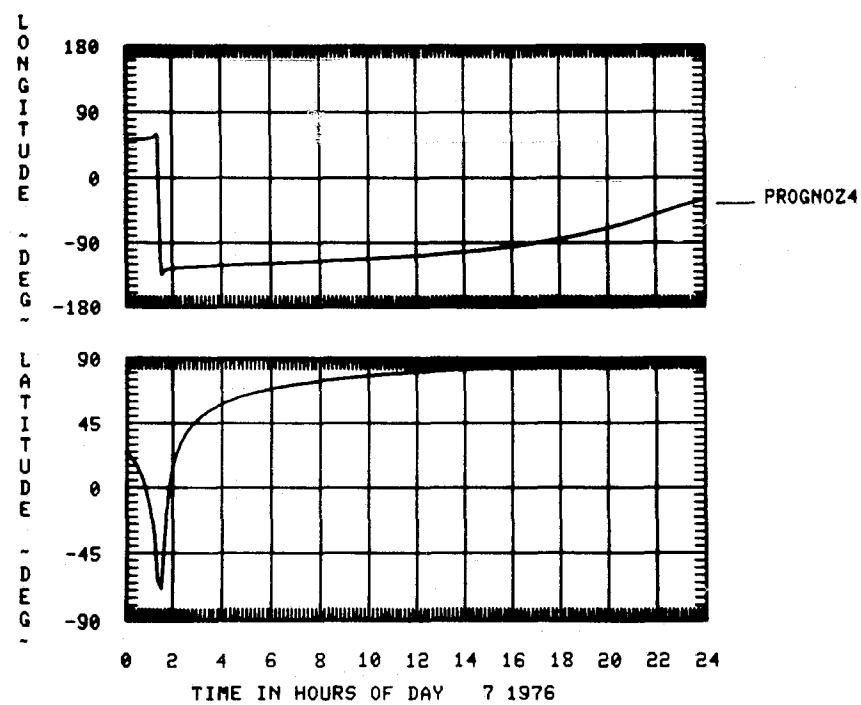


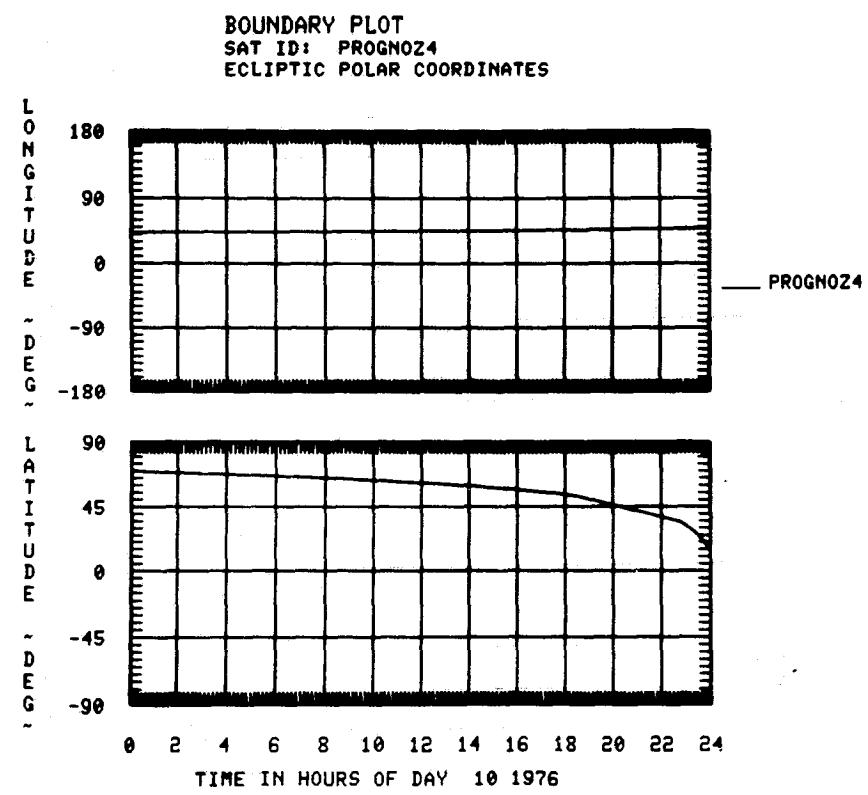
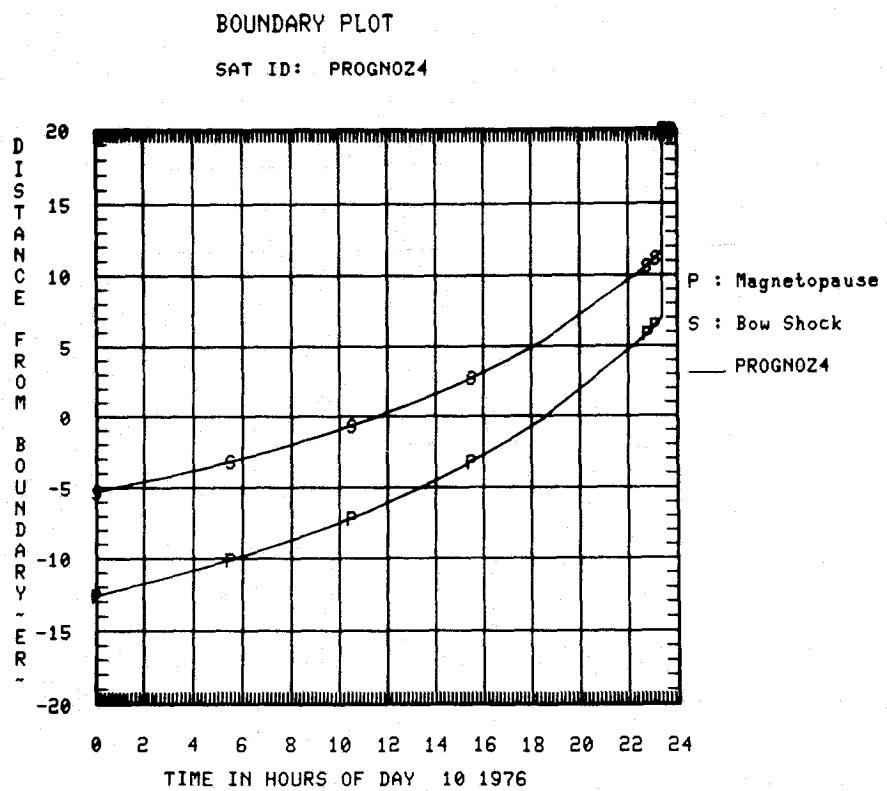
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SAT ID: PROGNOZA



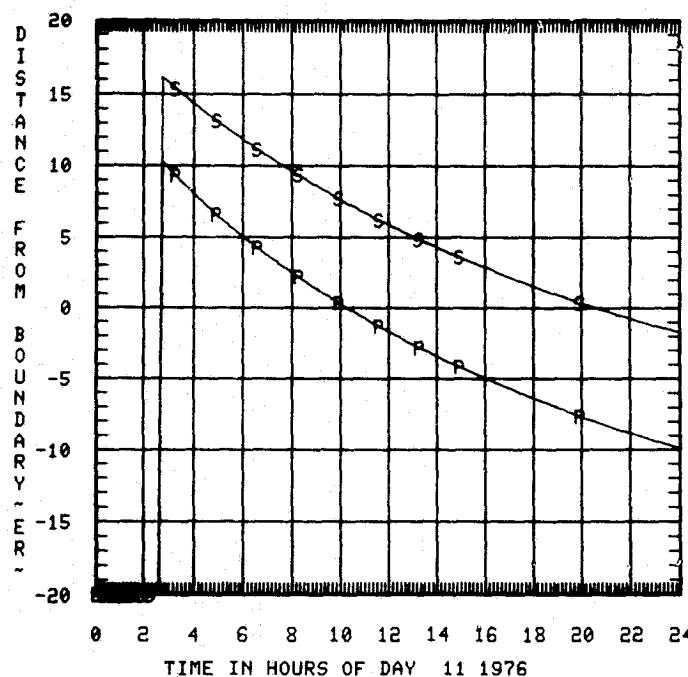
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SAT ID: PROGNOZA  
ECLIPTIC POLAR COORDINATES



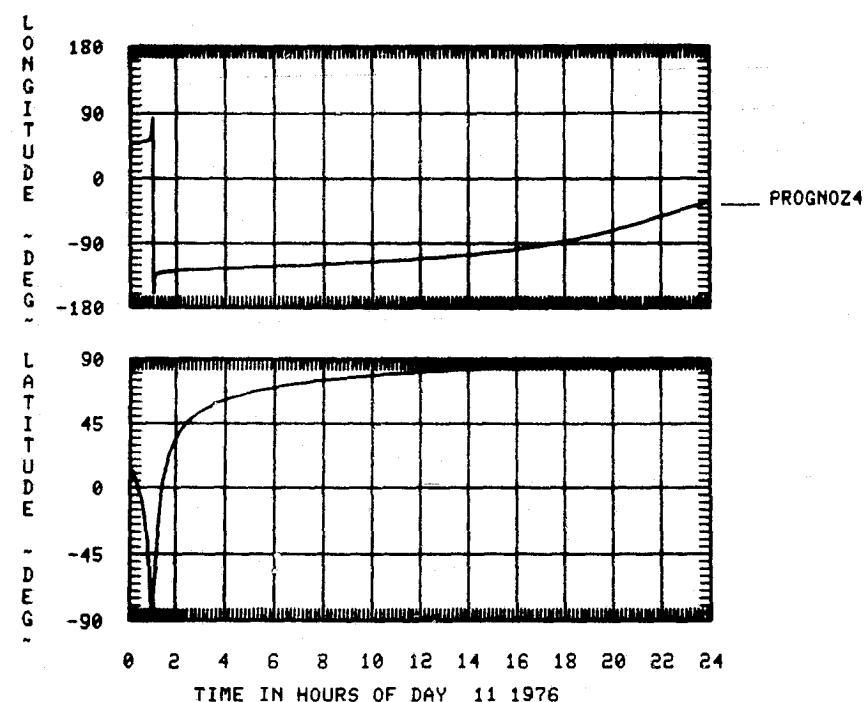


BOUNDARY PLOT

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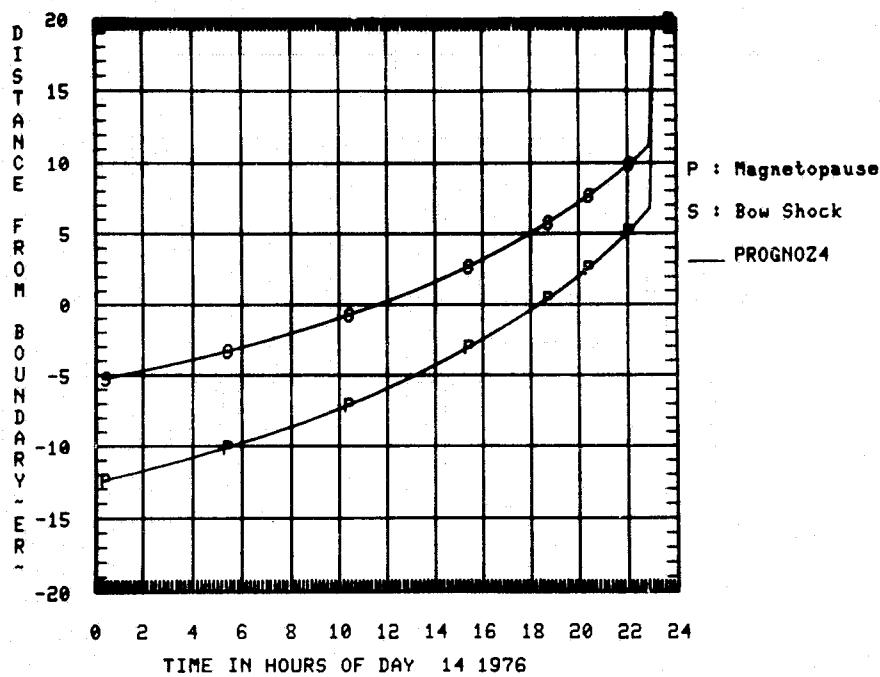


BOUNDARY PLOT  
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ECLiptic POLAR COORDINATES

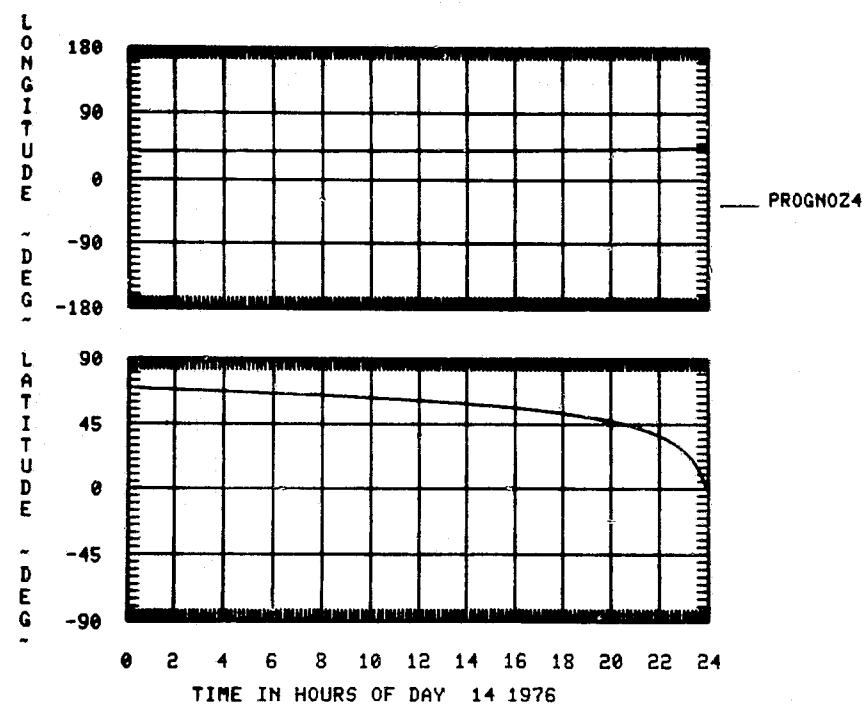


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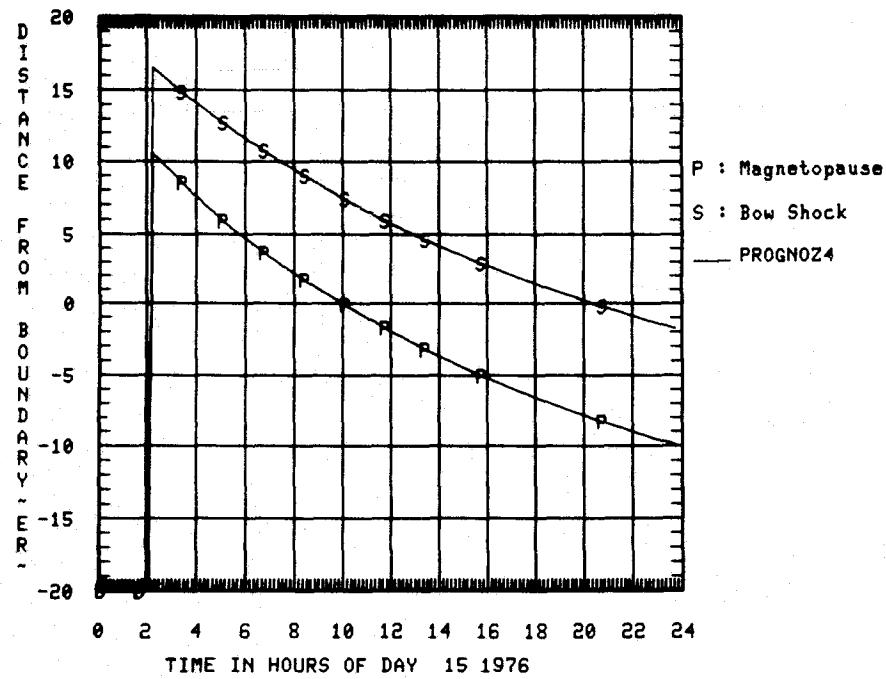


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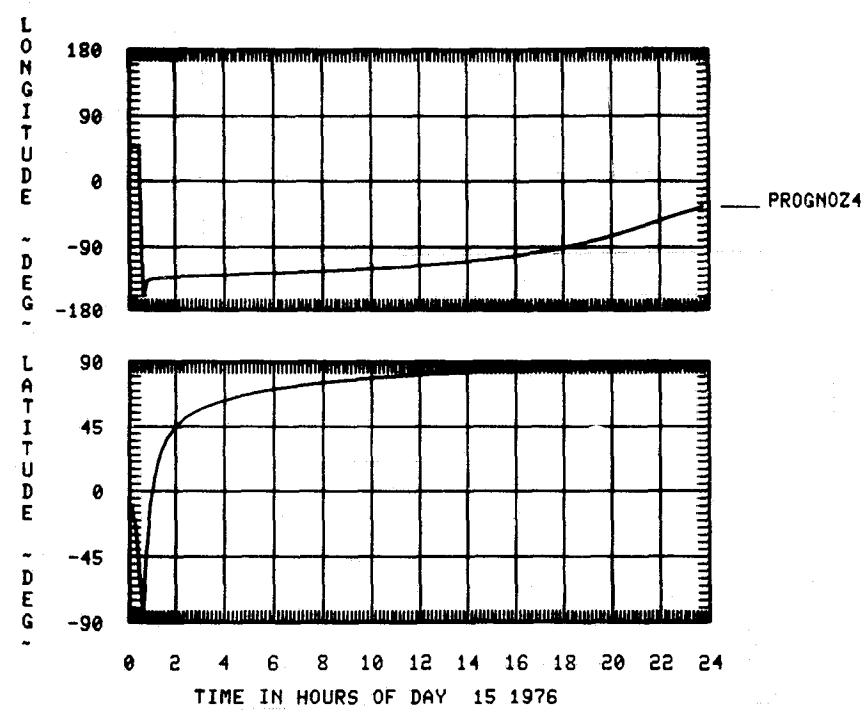


### BOUNDARY PLOT

SAT ID: PROGNOZ4

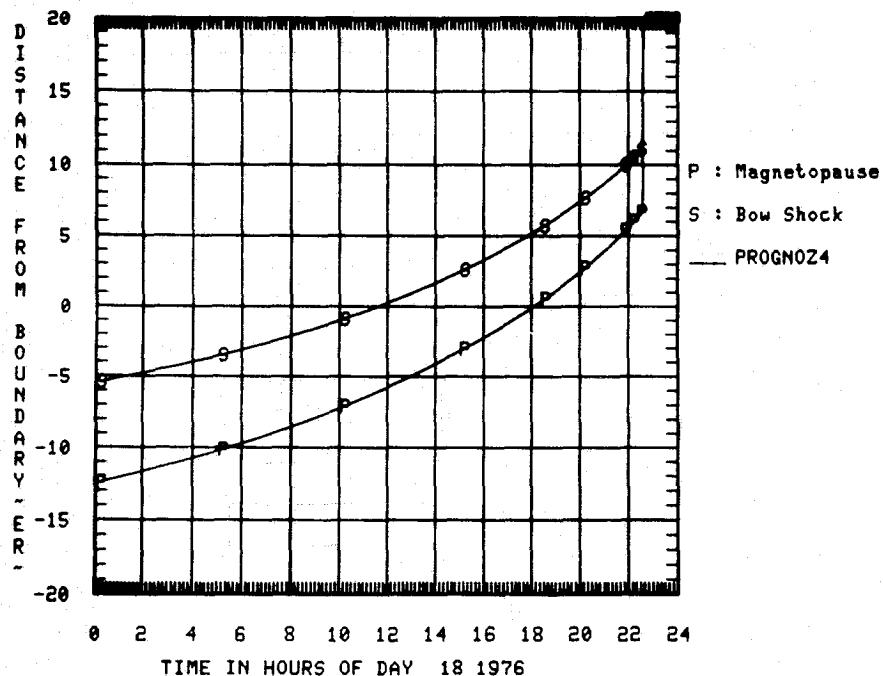


### BOUNDARY PLOT SAT ID: PROGNOZ4 ECLIPTIC POLAR COORDINATES

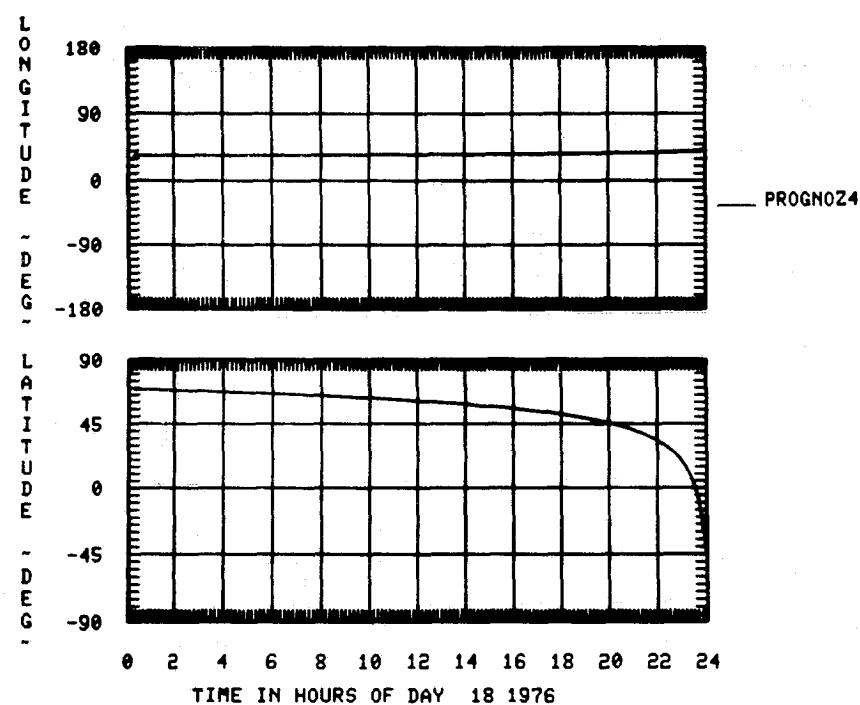


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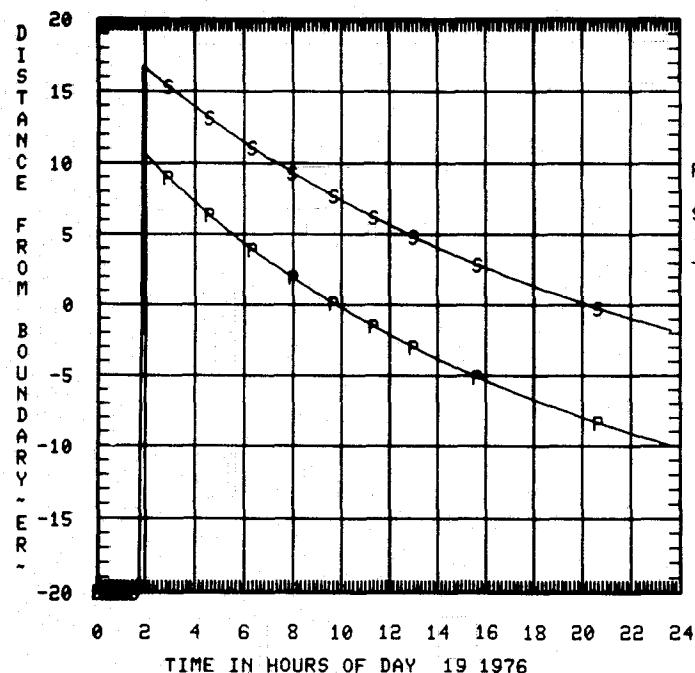


BOUNDARY PLOT  
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ECLIPTIC POLAR COORDINATES



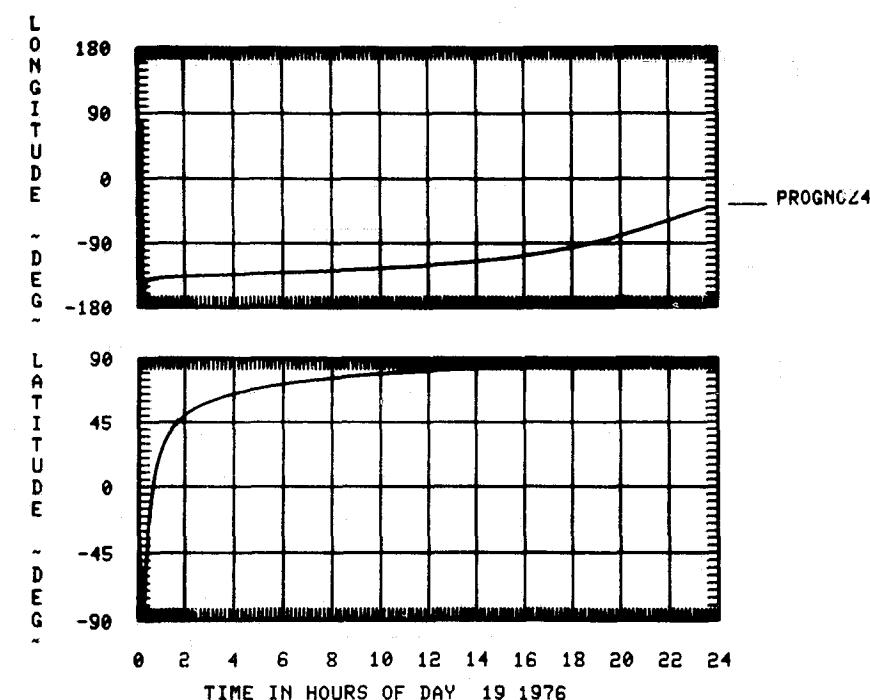
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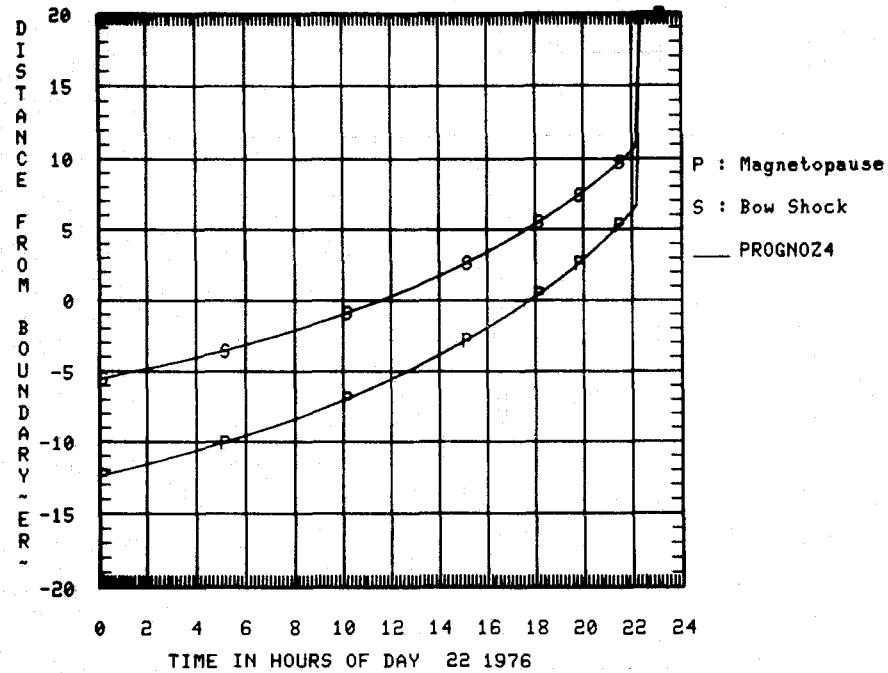


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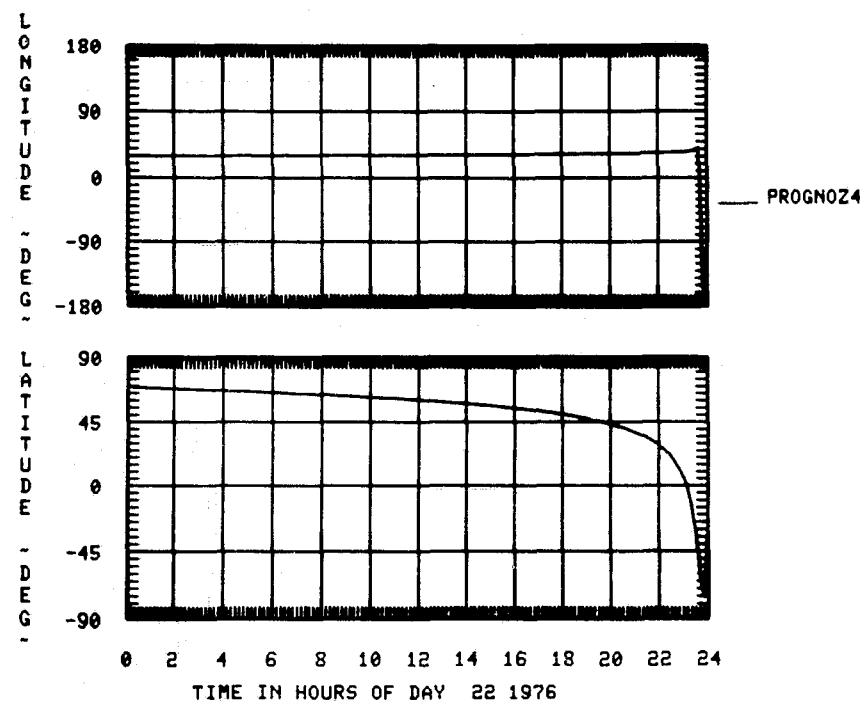
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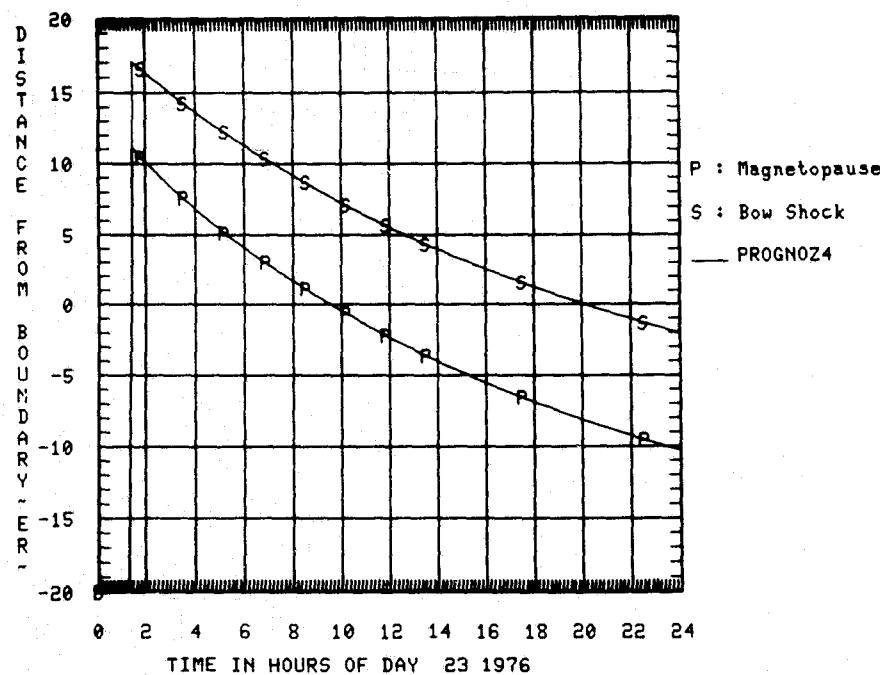


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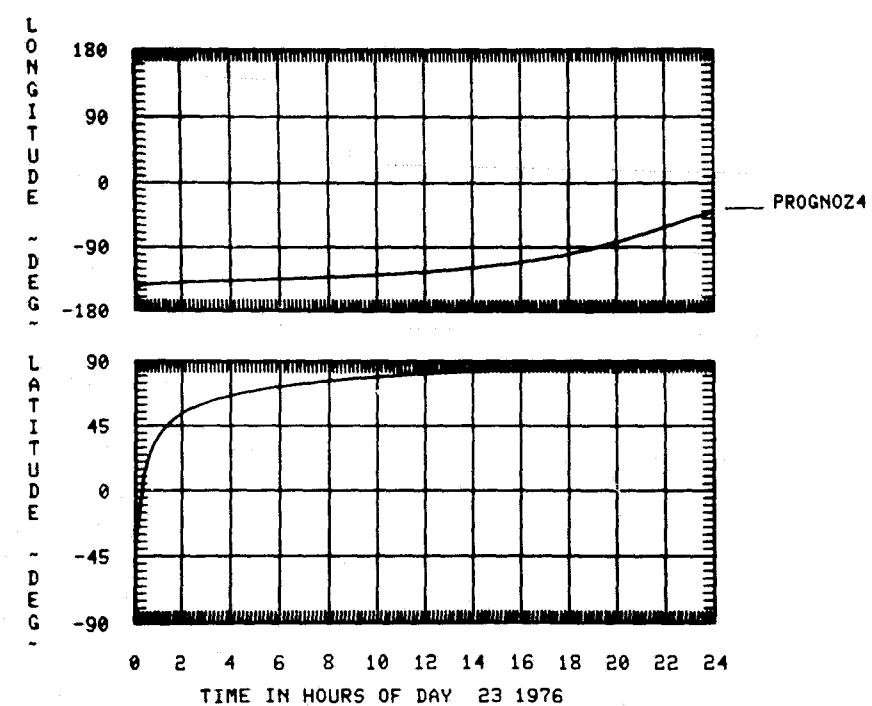
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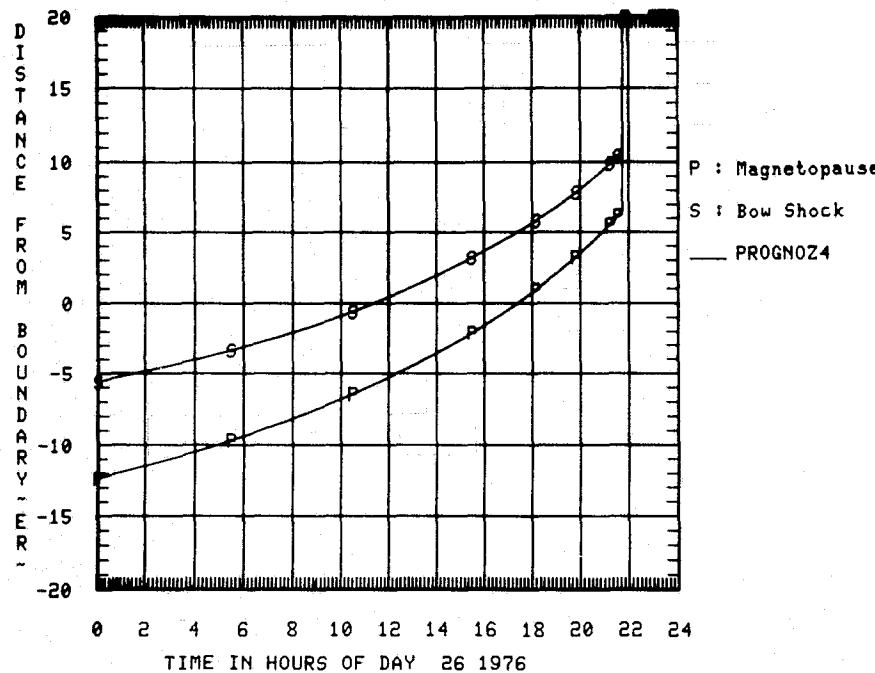
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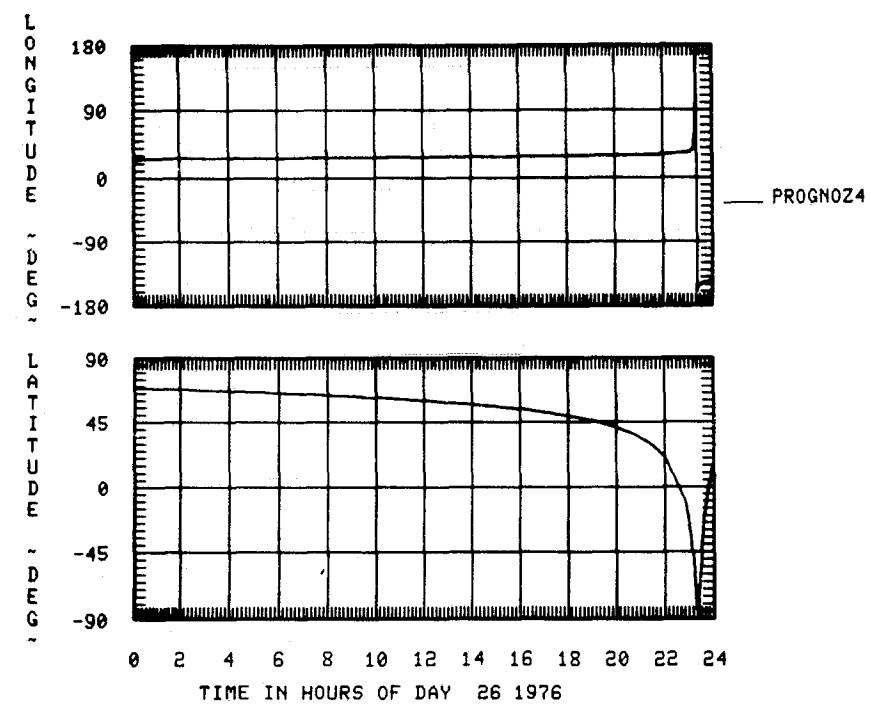
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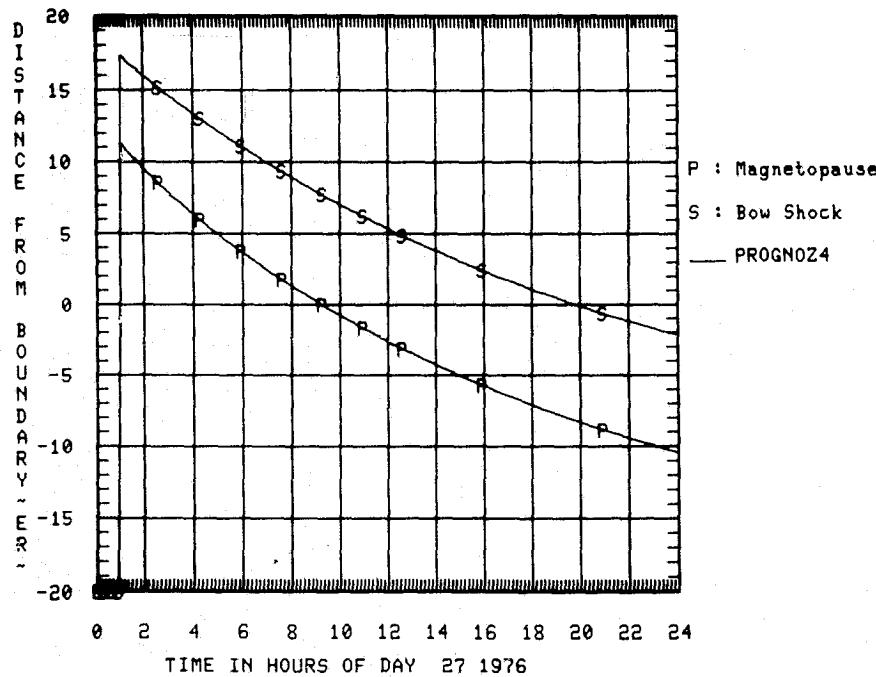
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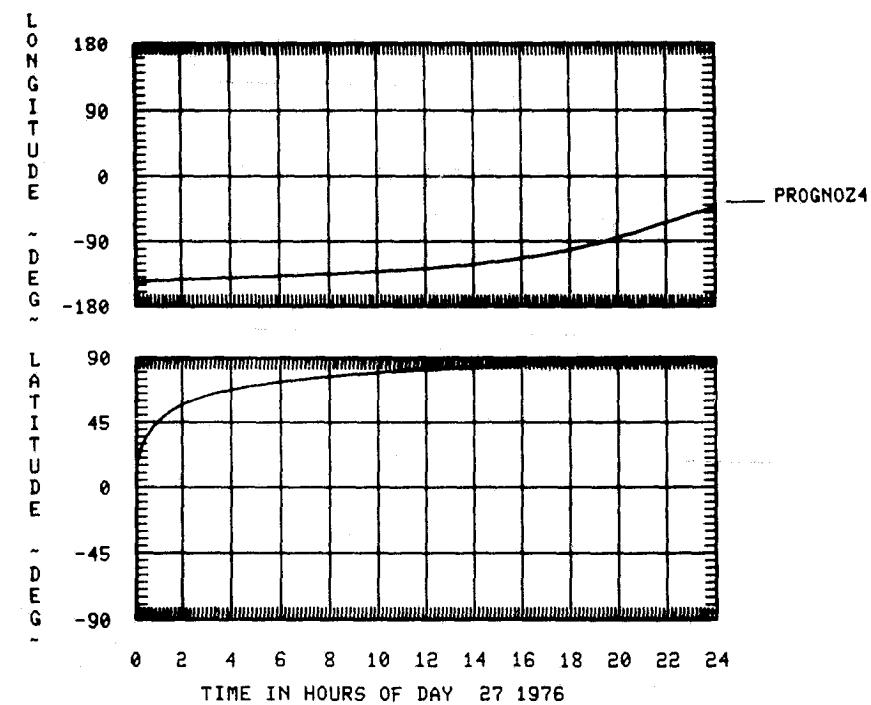
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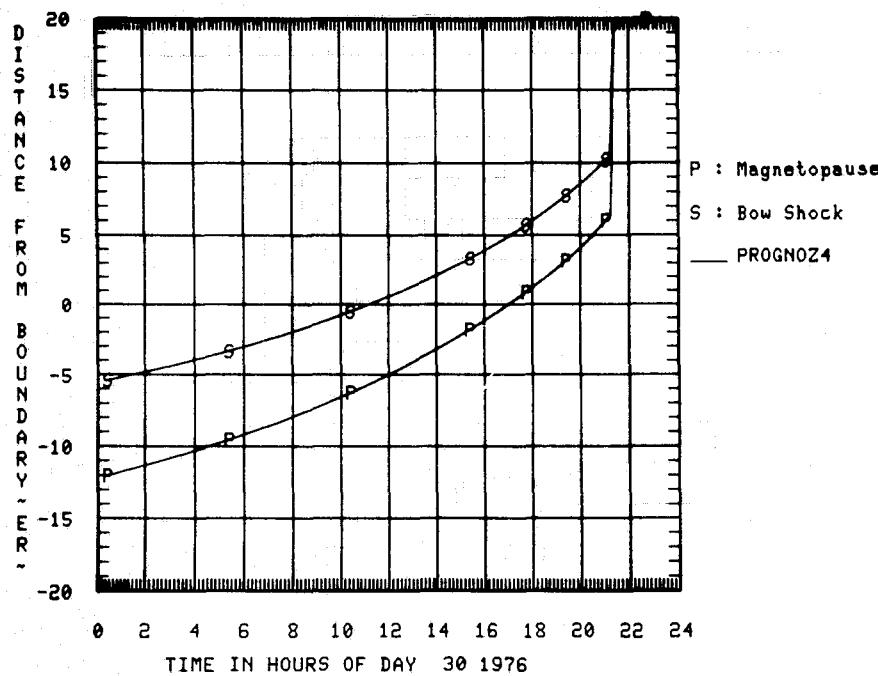
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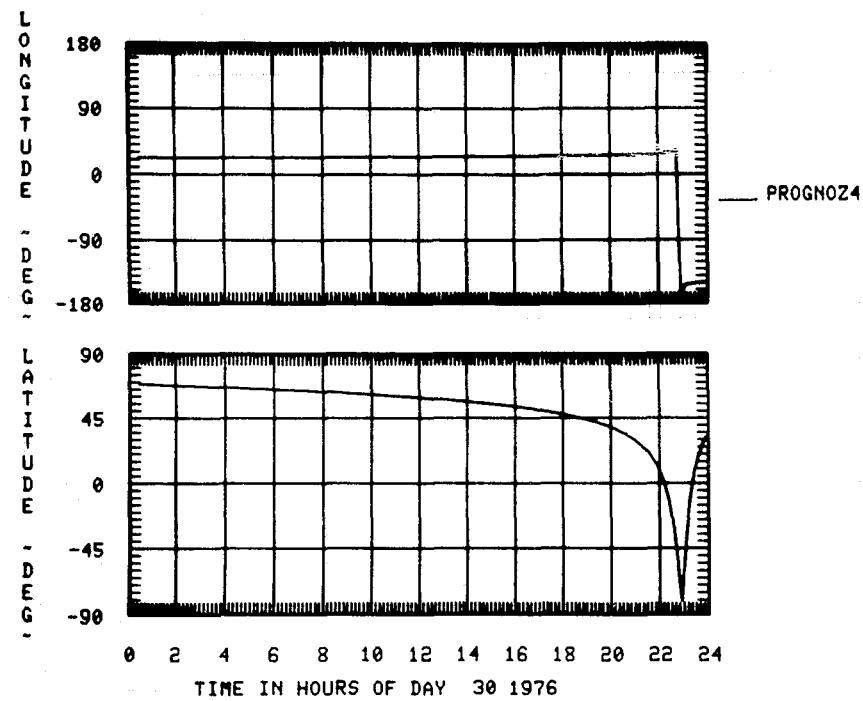


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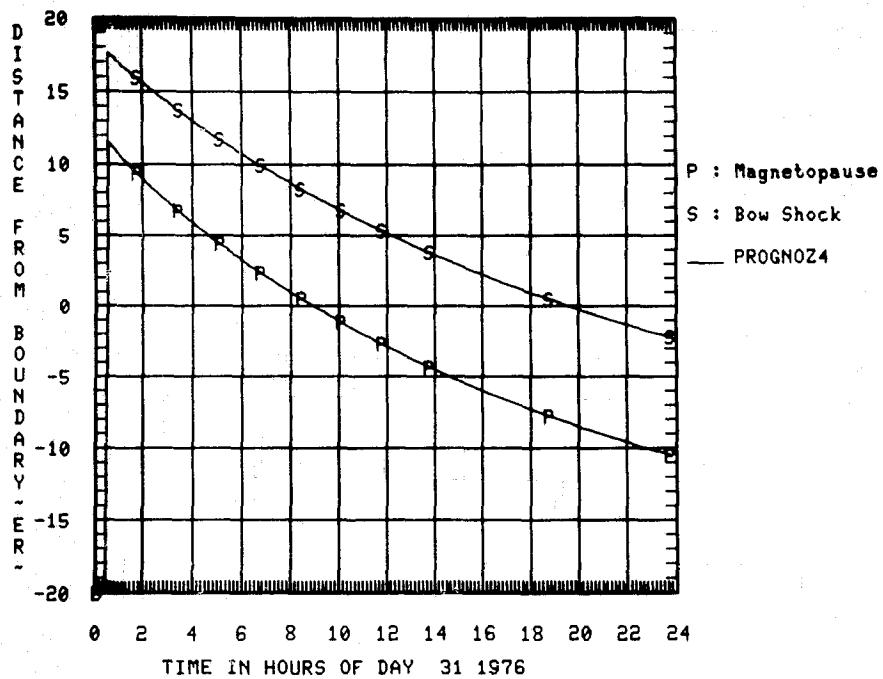


**BOUNDARY PLOT**  
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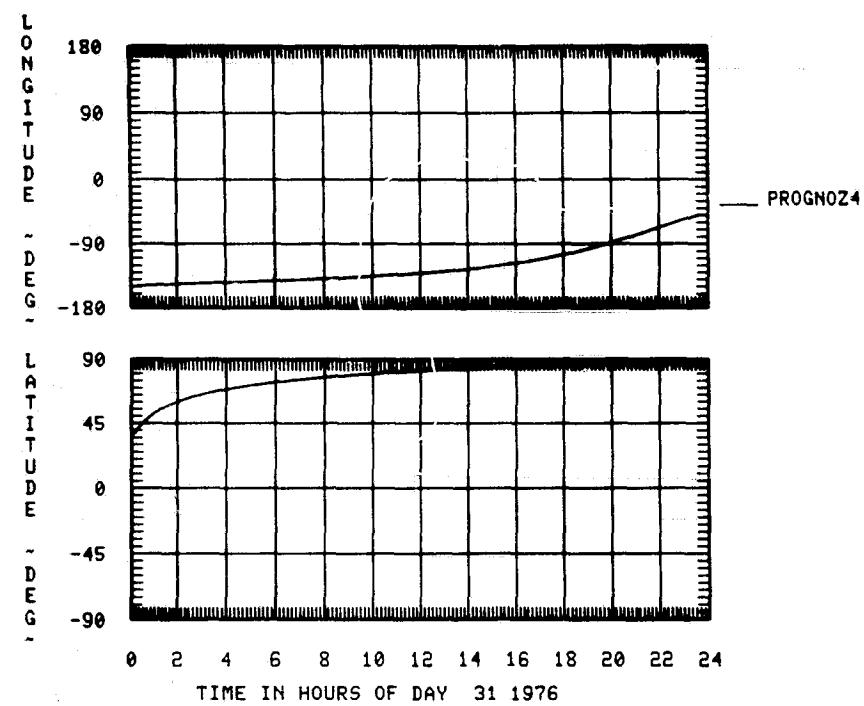
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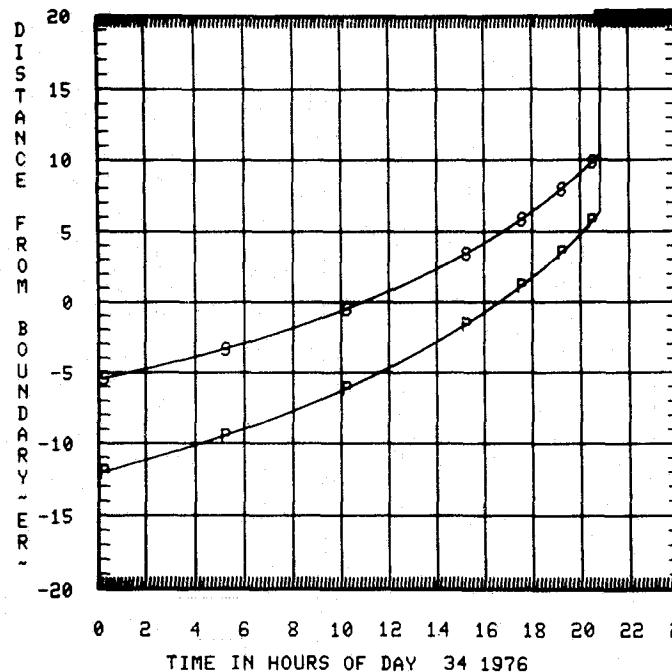
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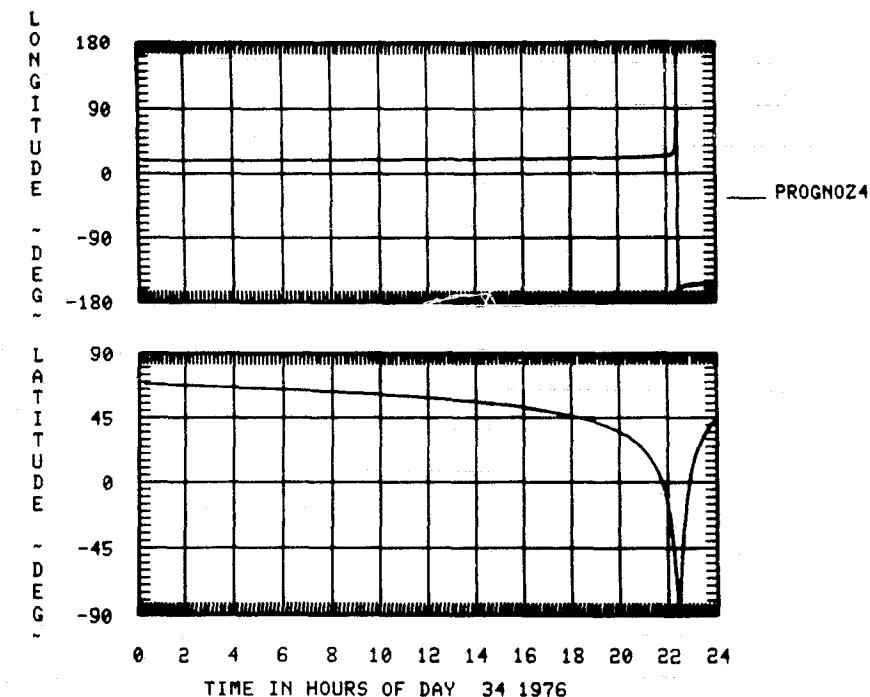
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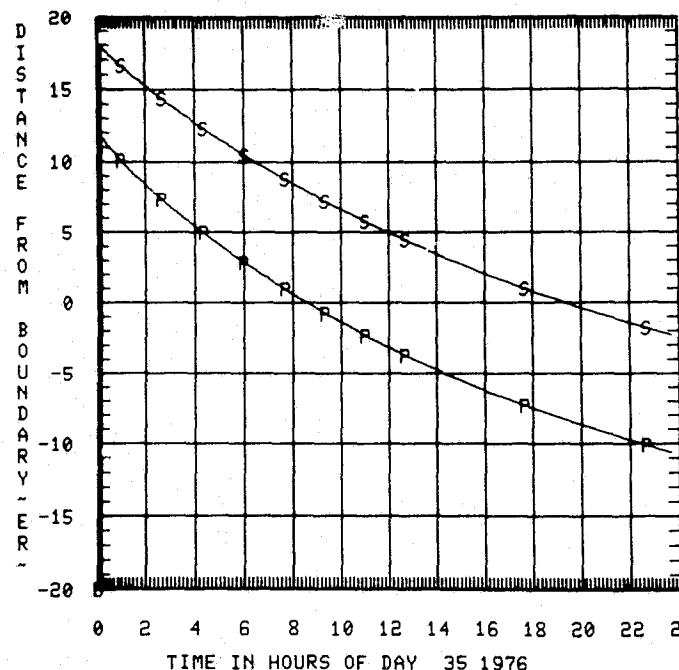
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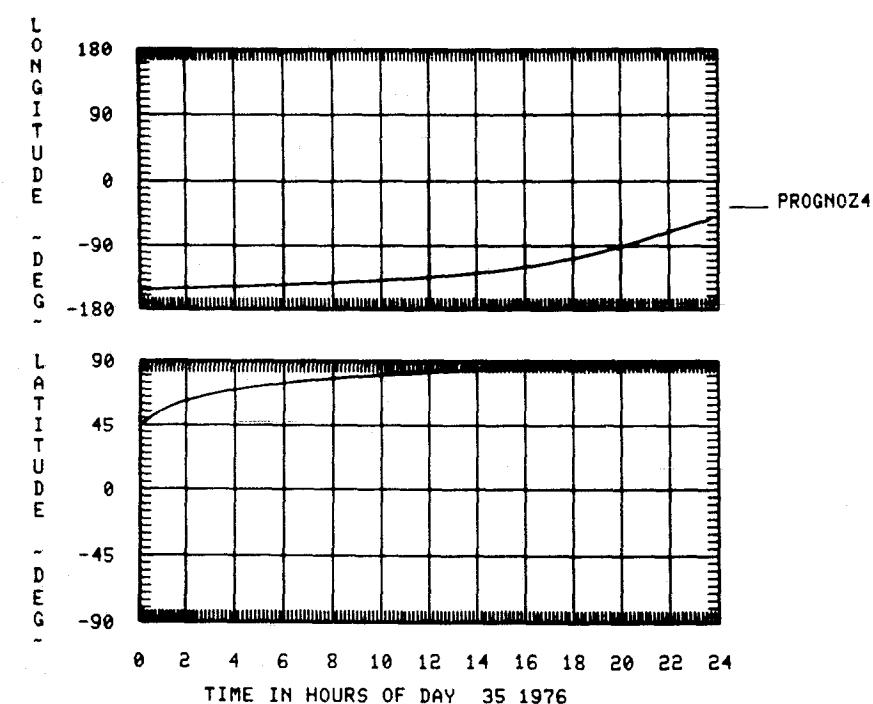
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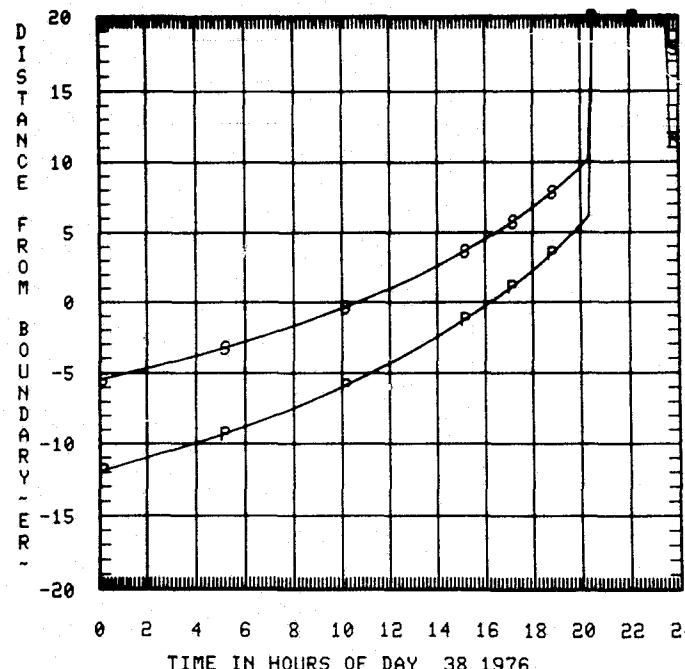
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ECLIPTIC POLAR COORDINATES



### BOUNDARY PLOT

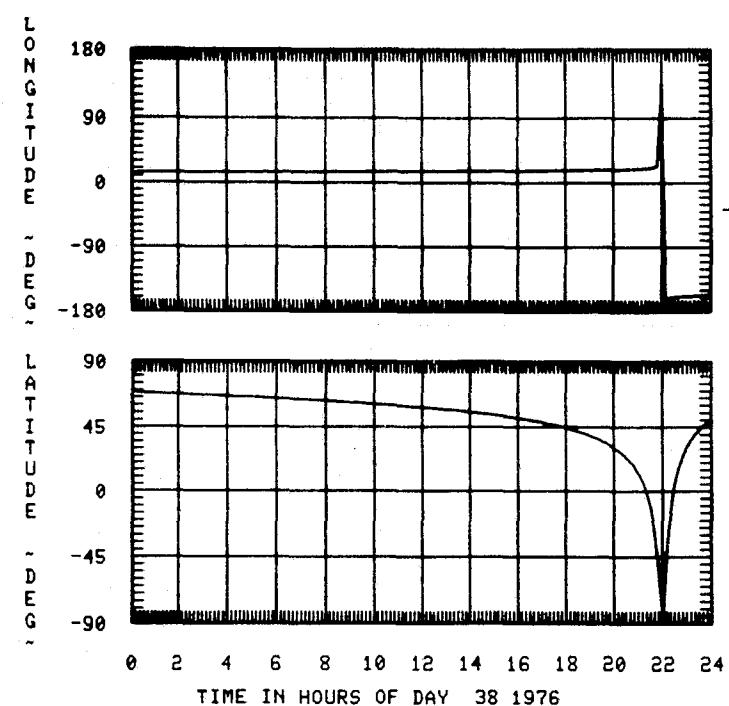
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P : Magnetopause  
S : Bow Shock  
— PROGNOZ4

### BOUNDARY PLOT

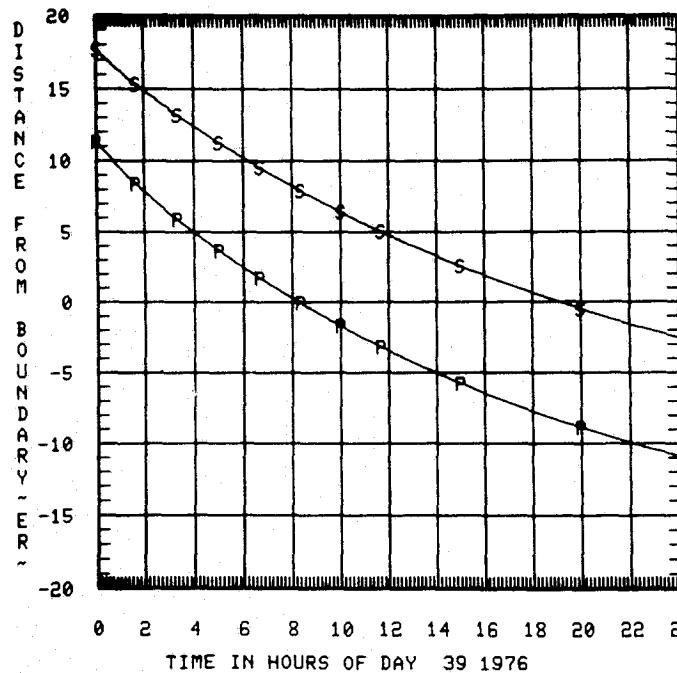
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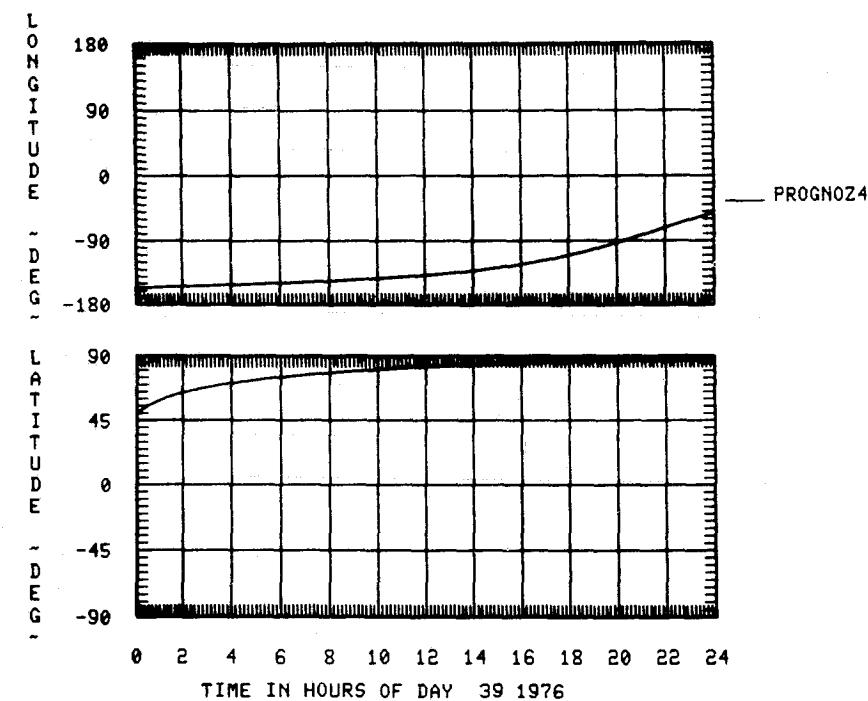
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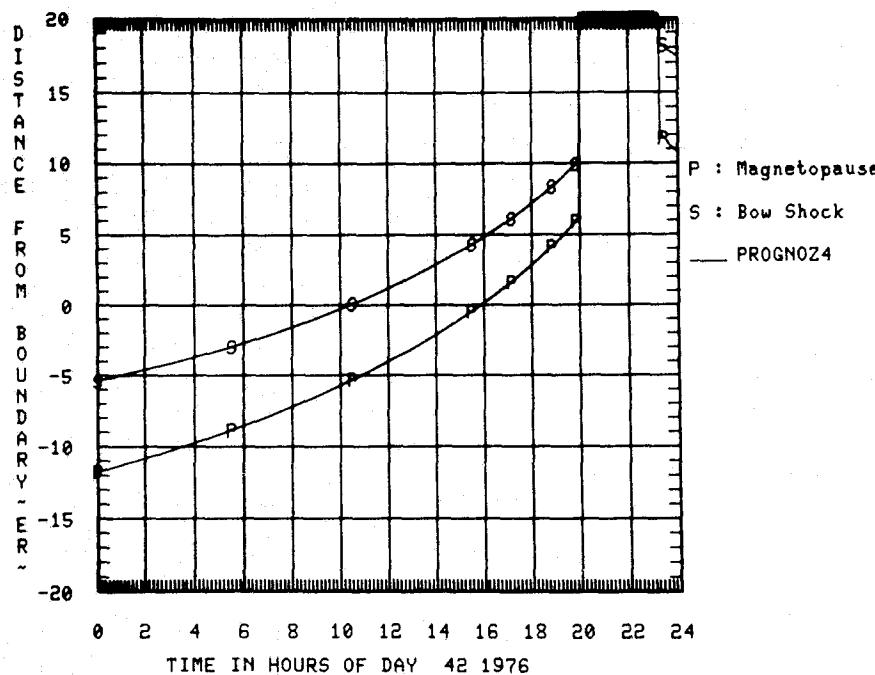
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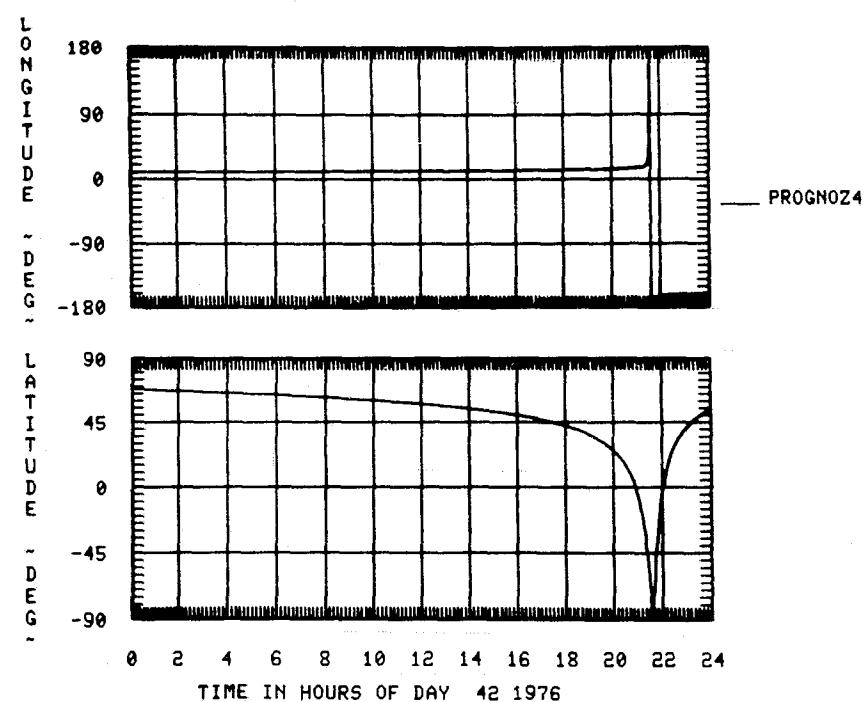


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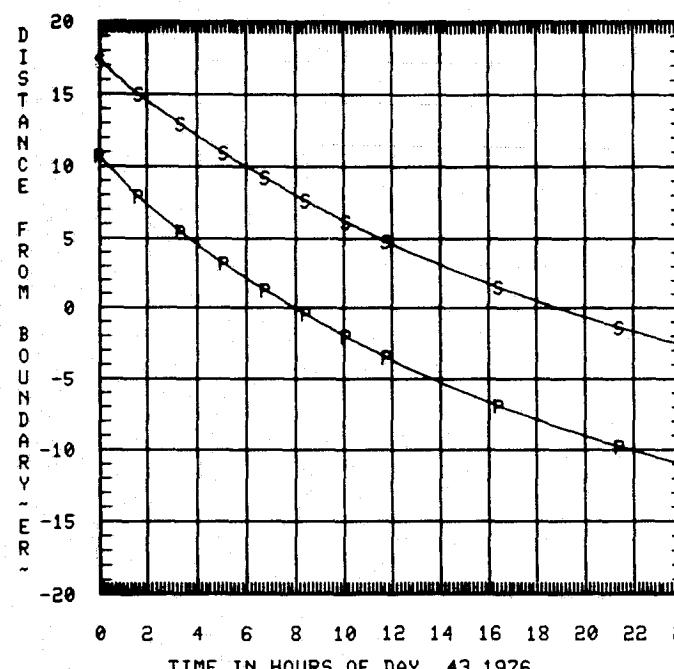


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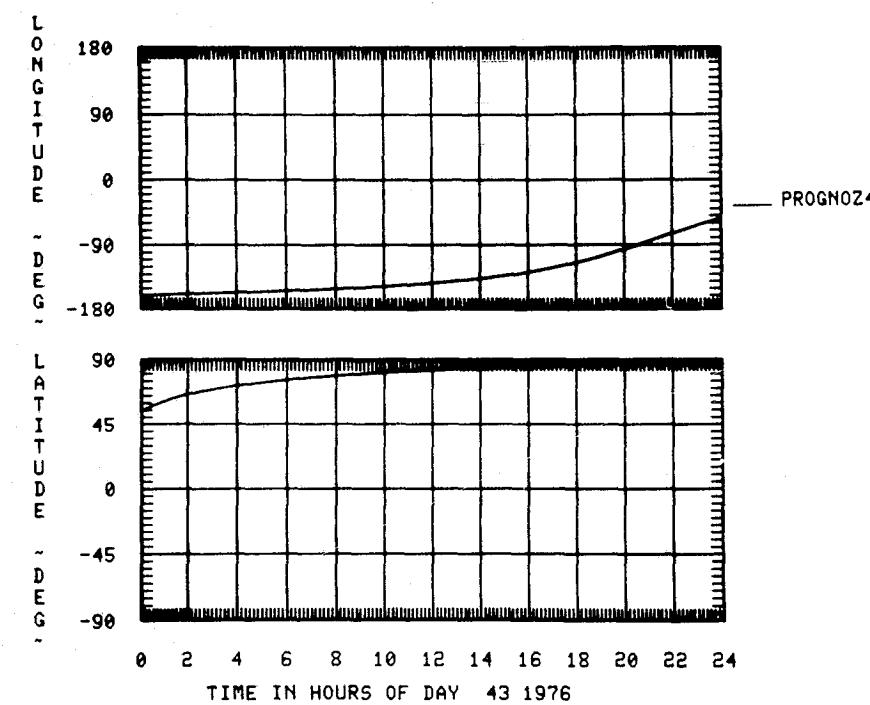
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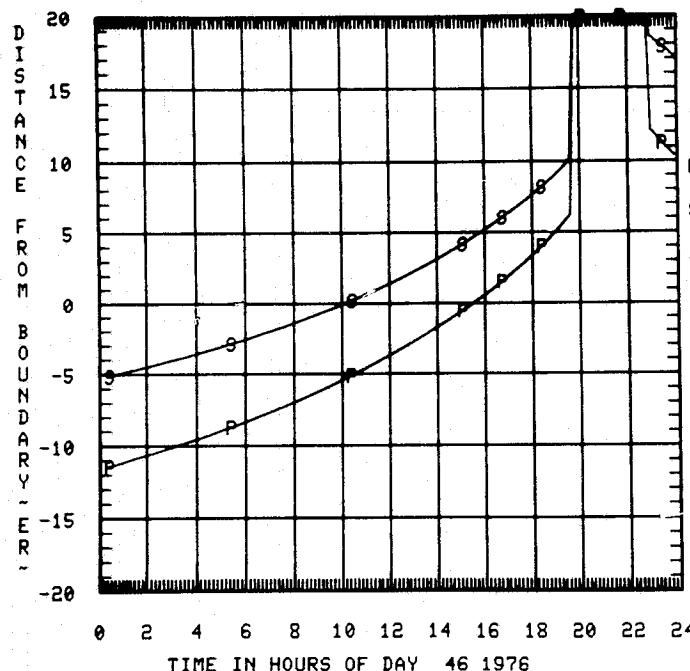
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ECLIPTIC POLAR COORDINATES



BOUNDARY PLOT

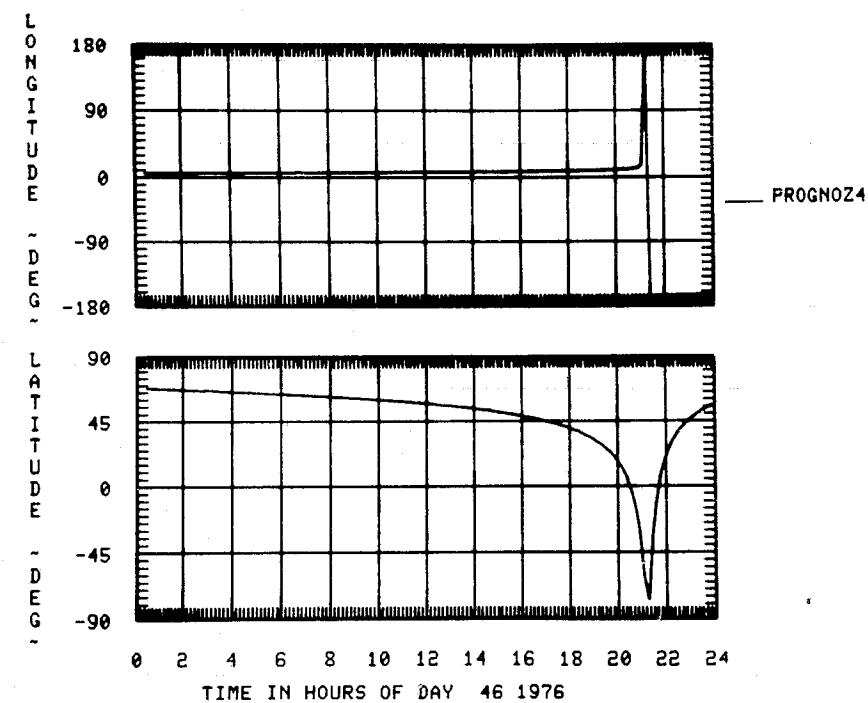
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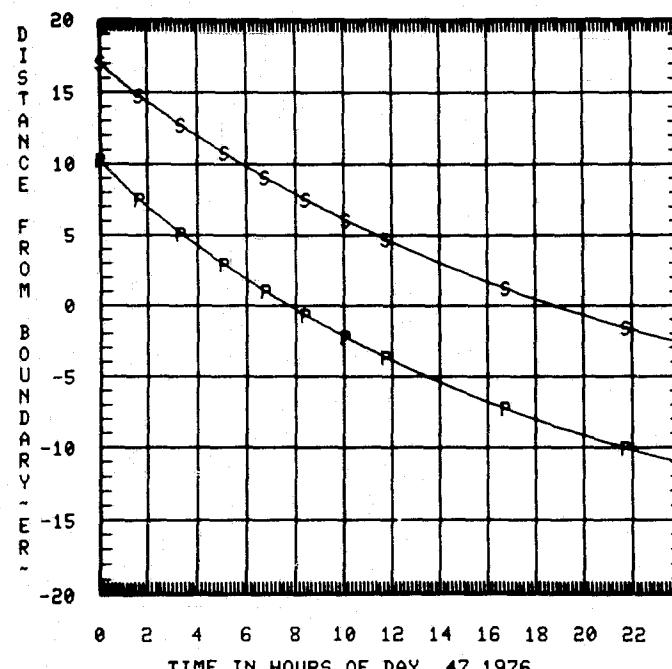
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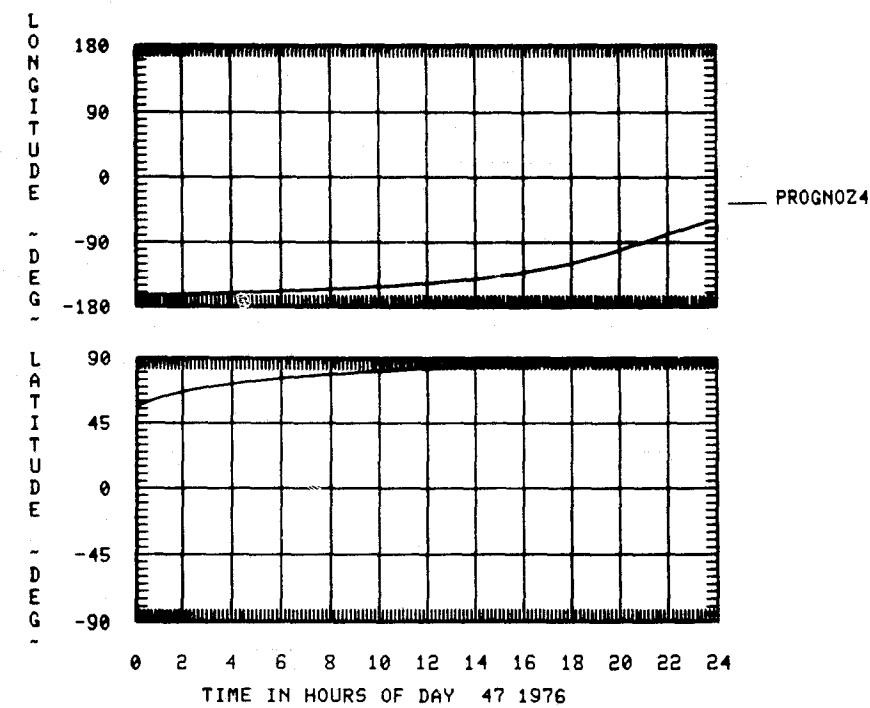
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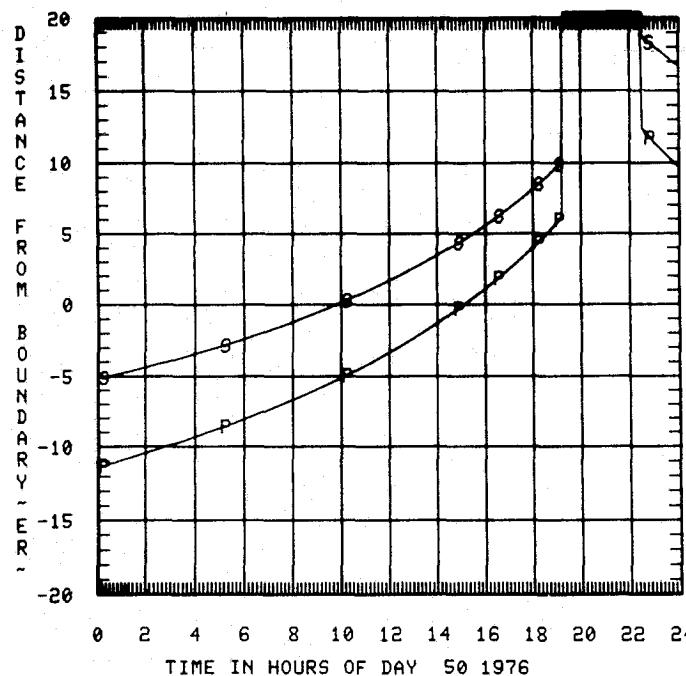
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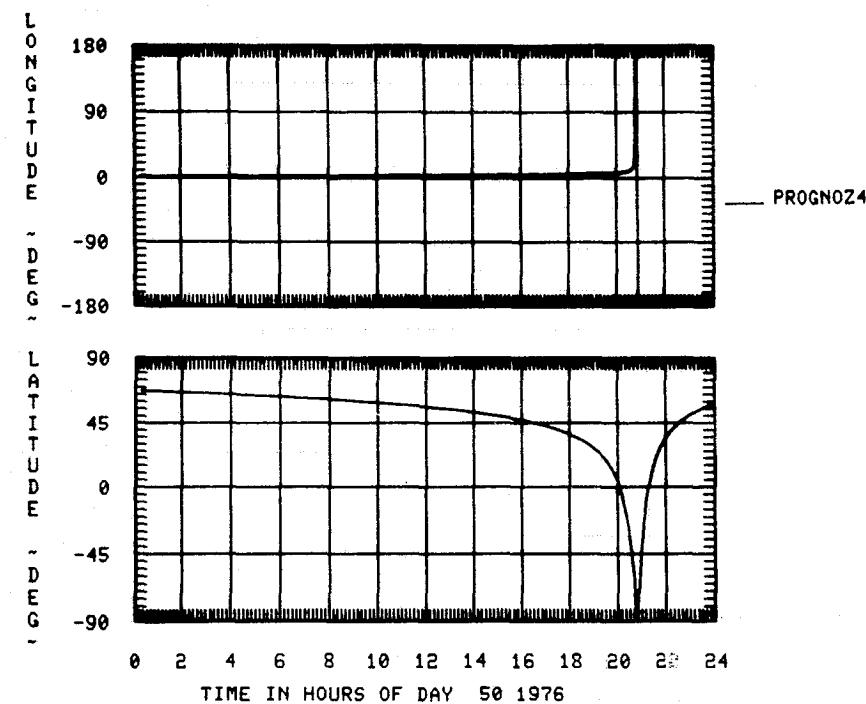
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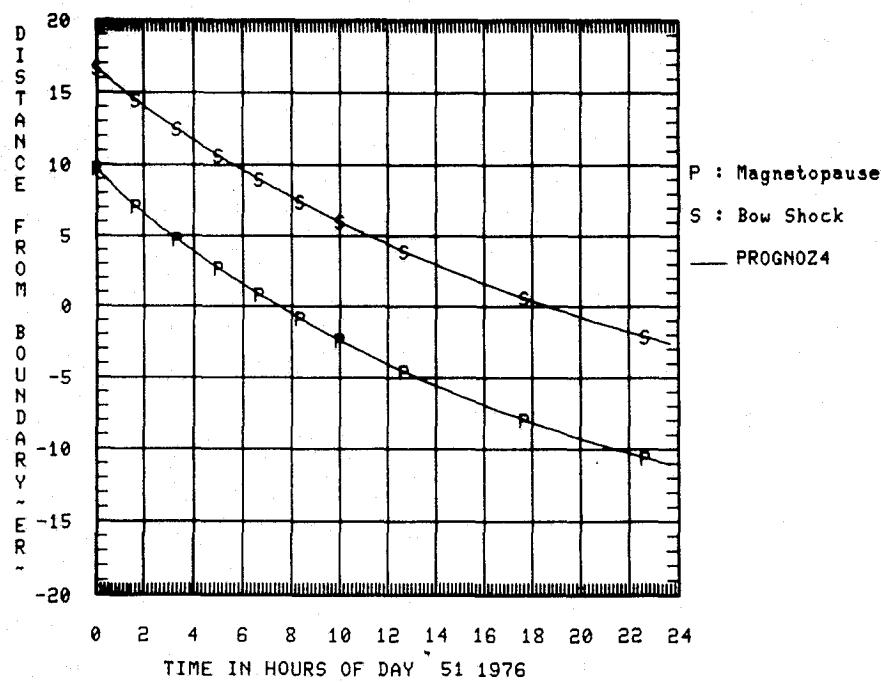
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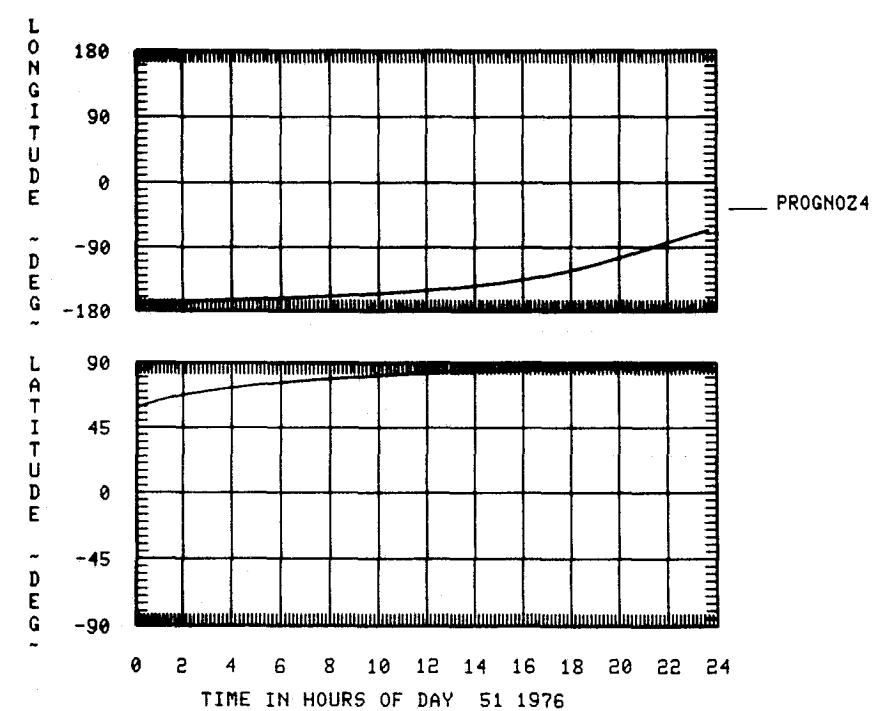


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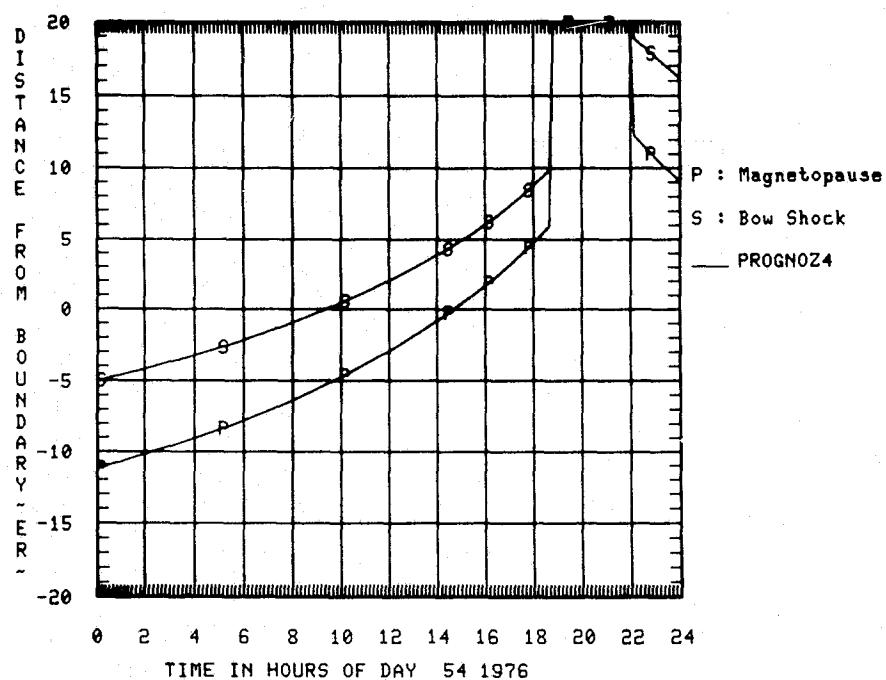


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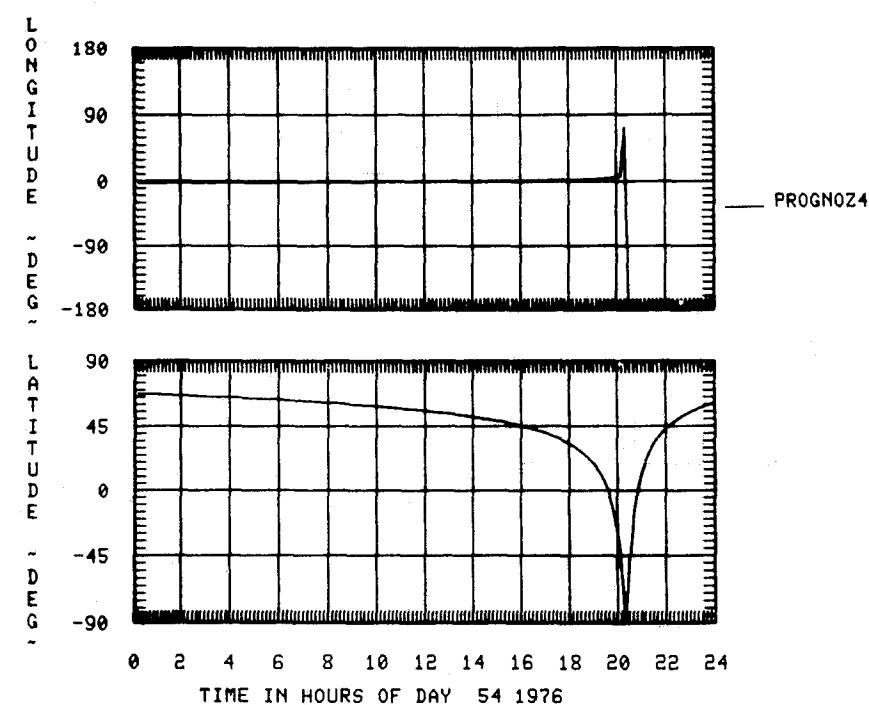
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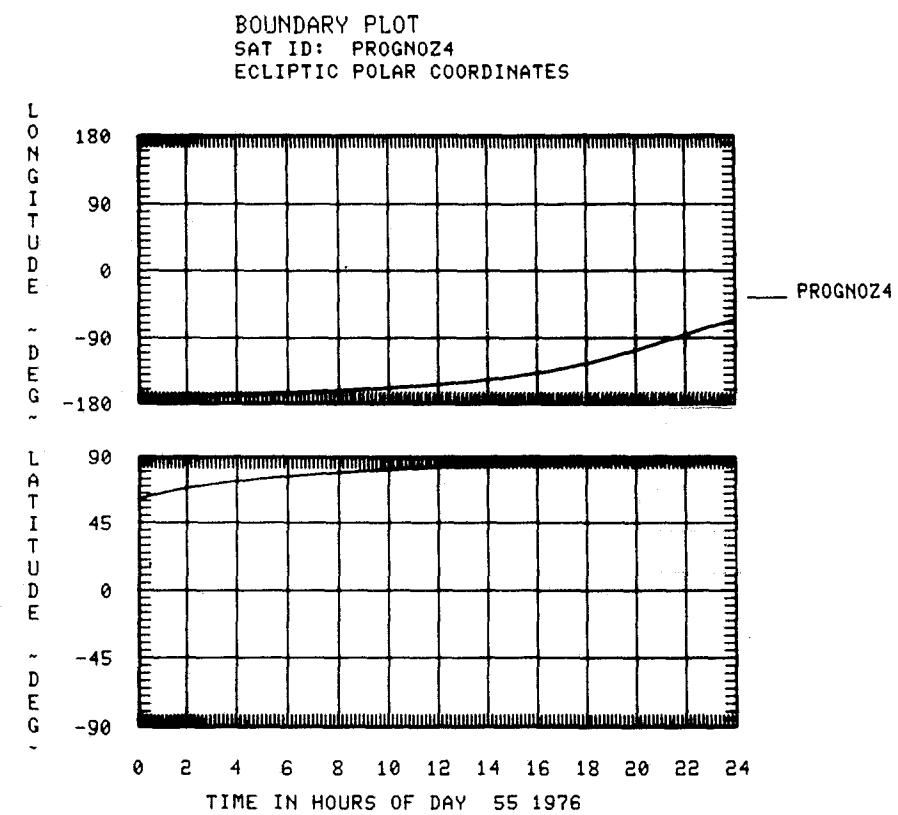
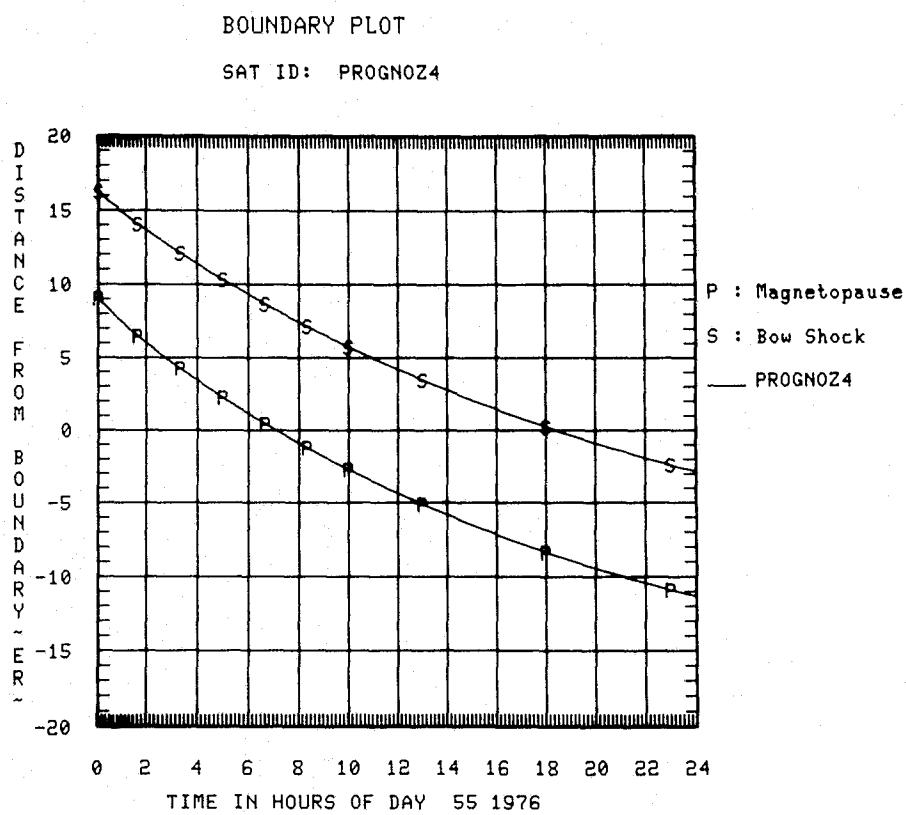
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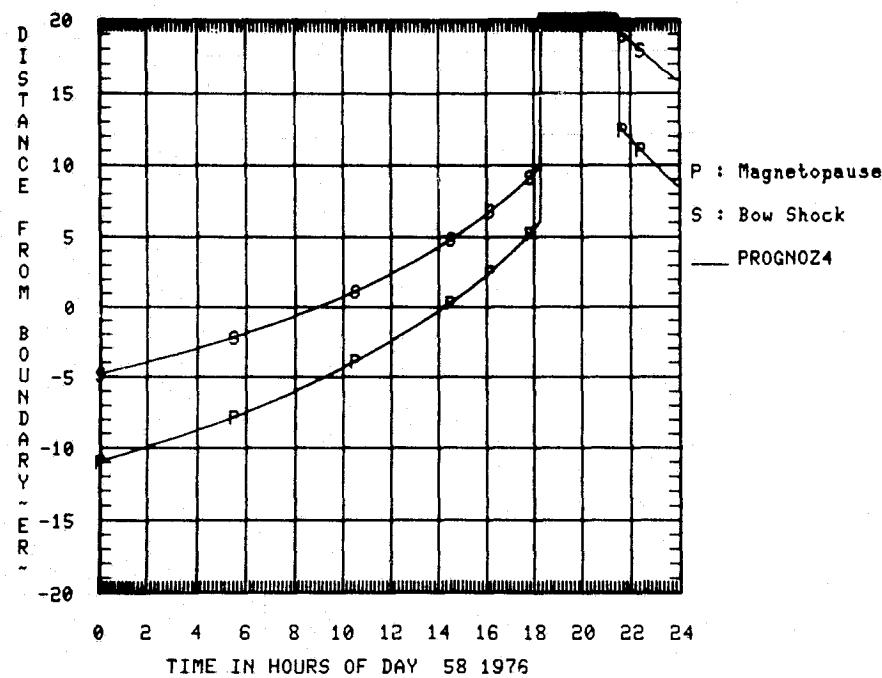
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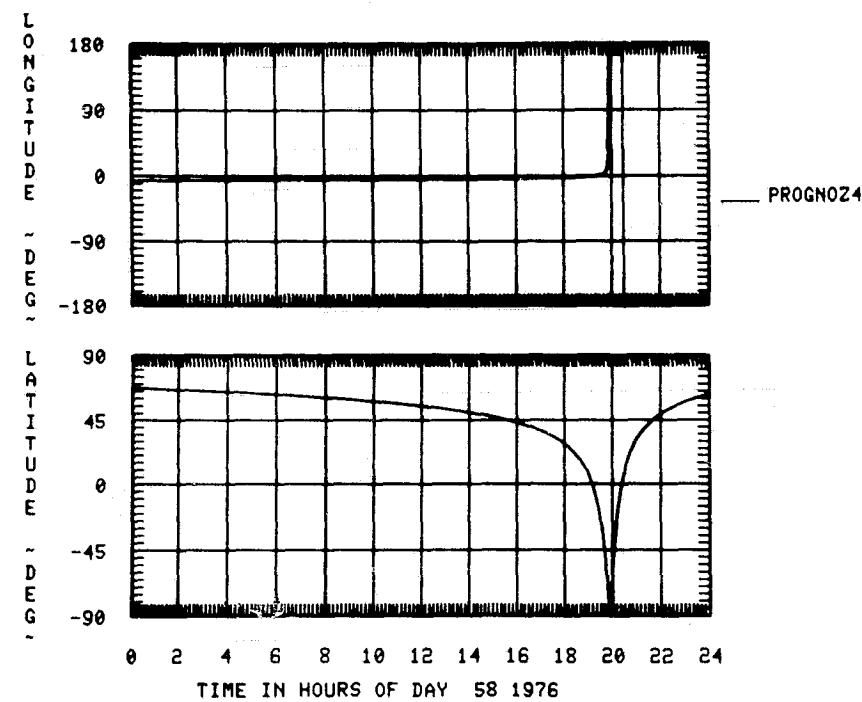
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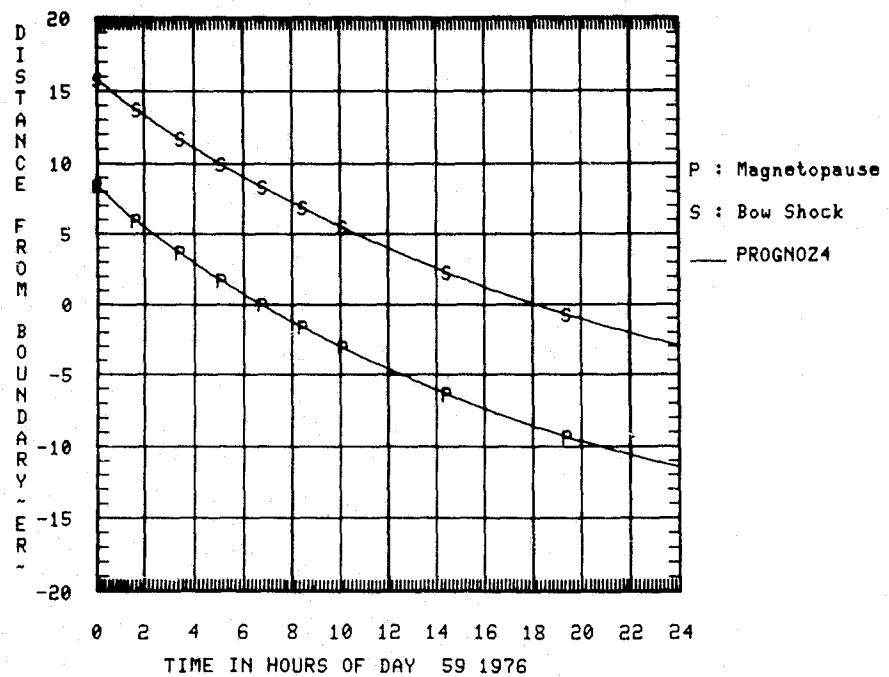
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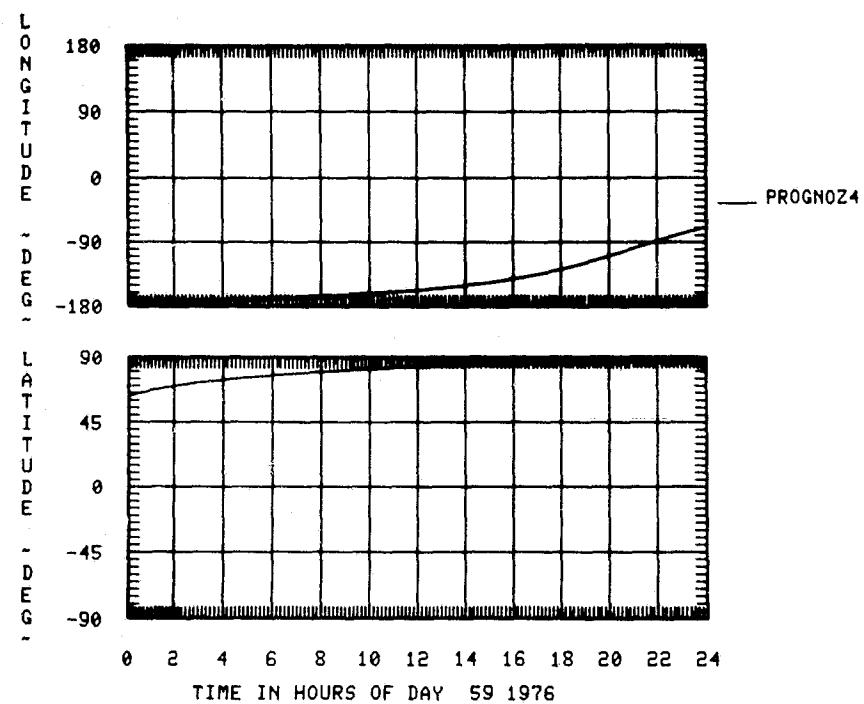
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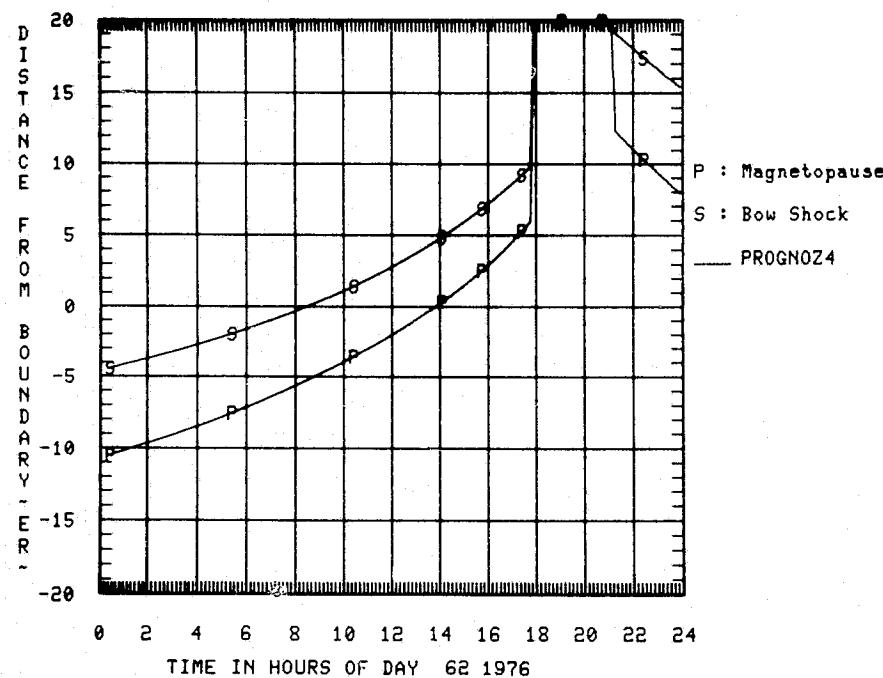
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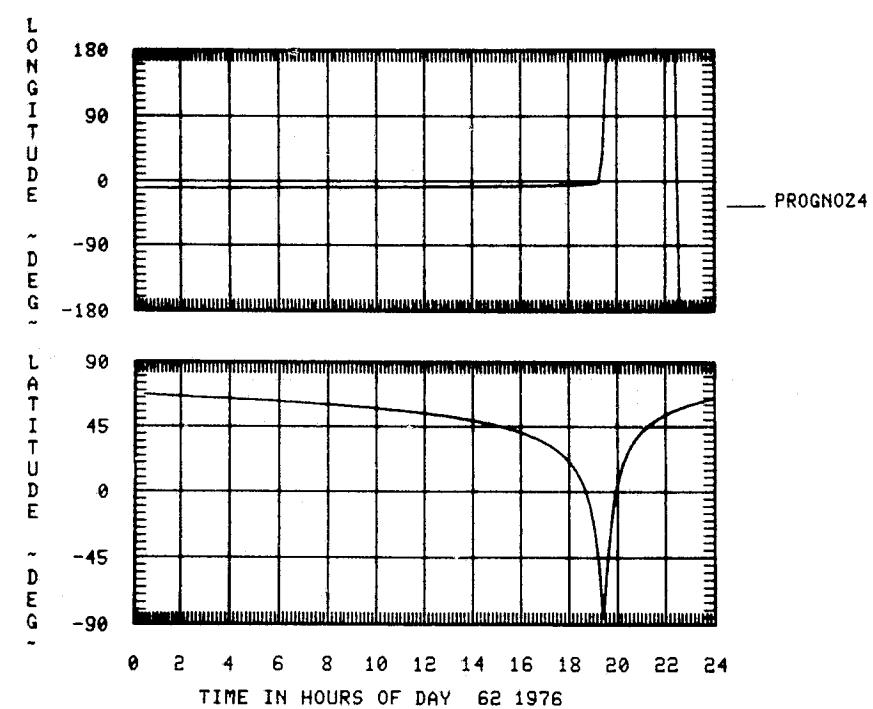


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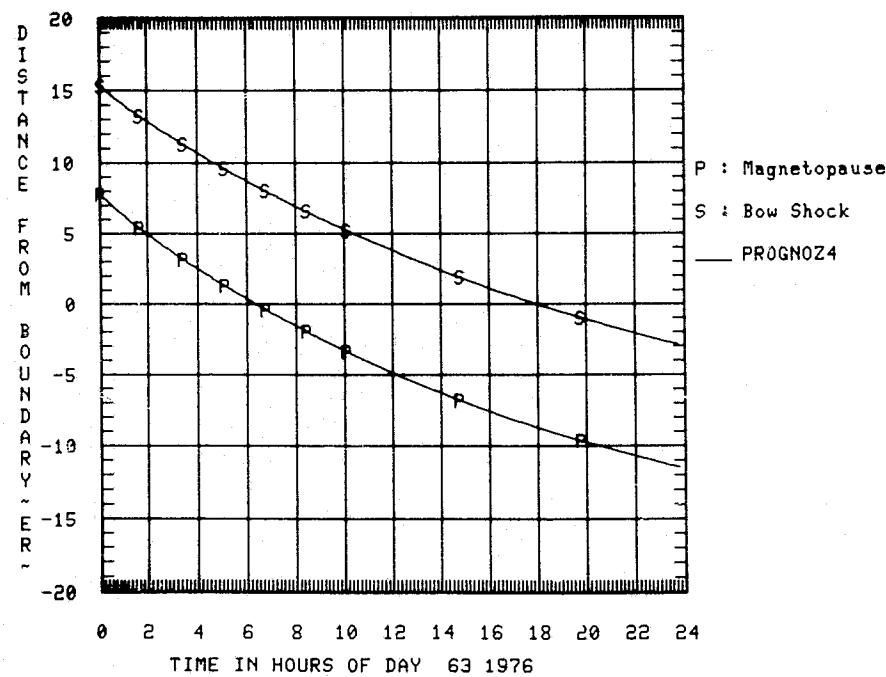


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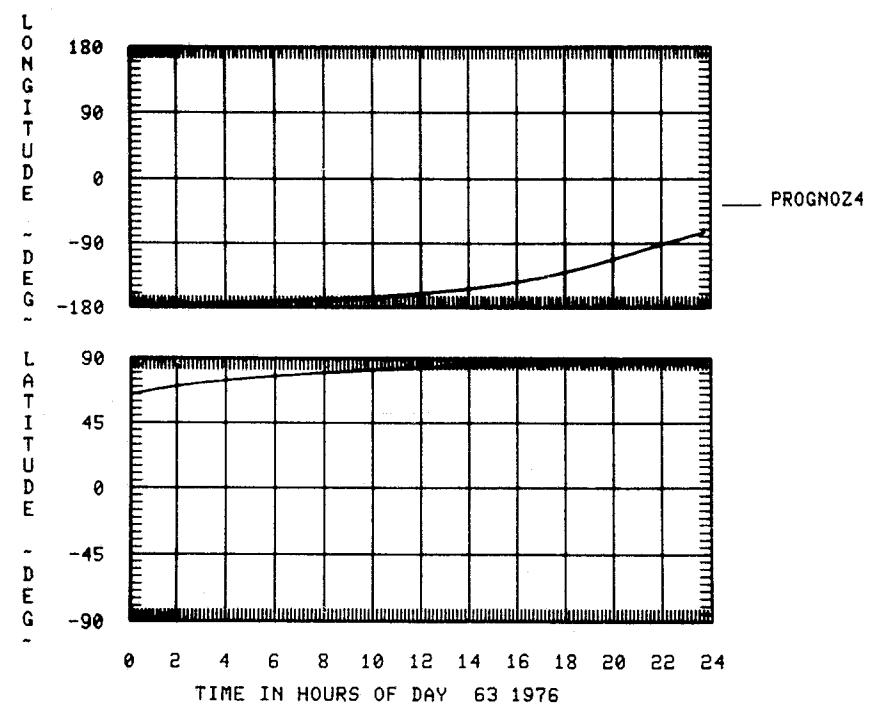
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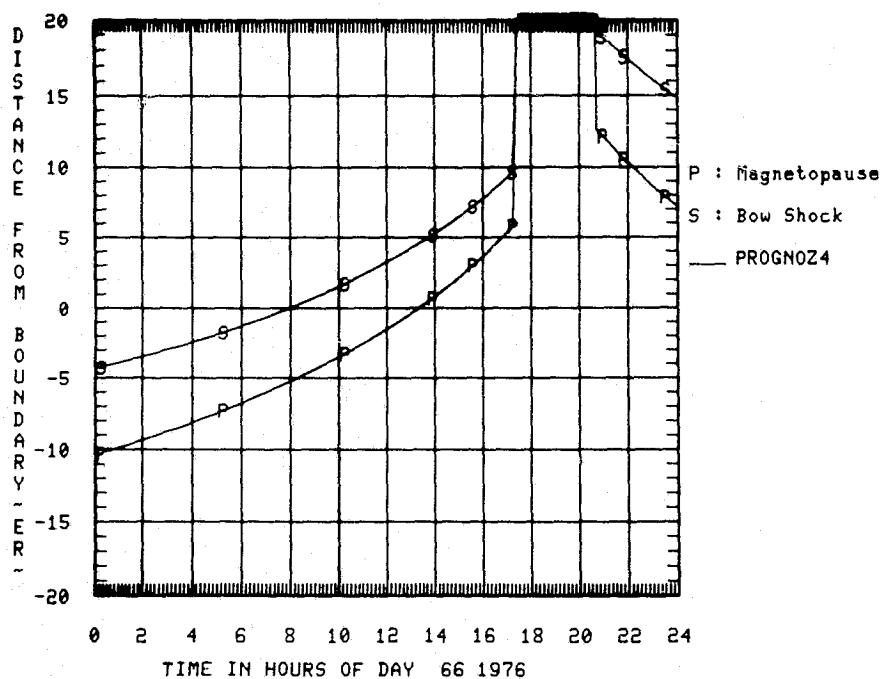
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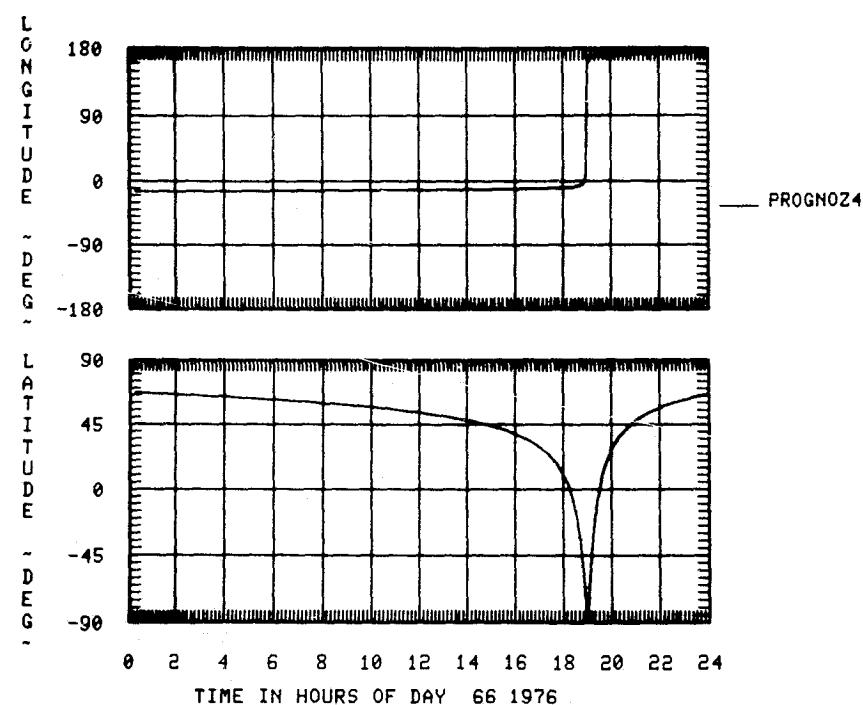
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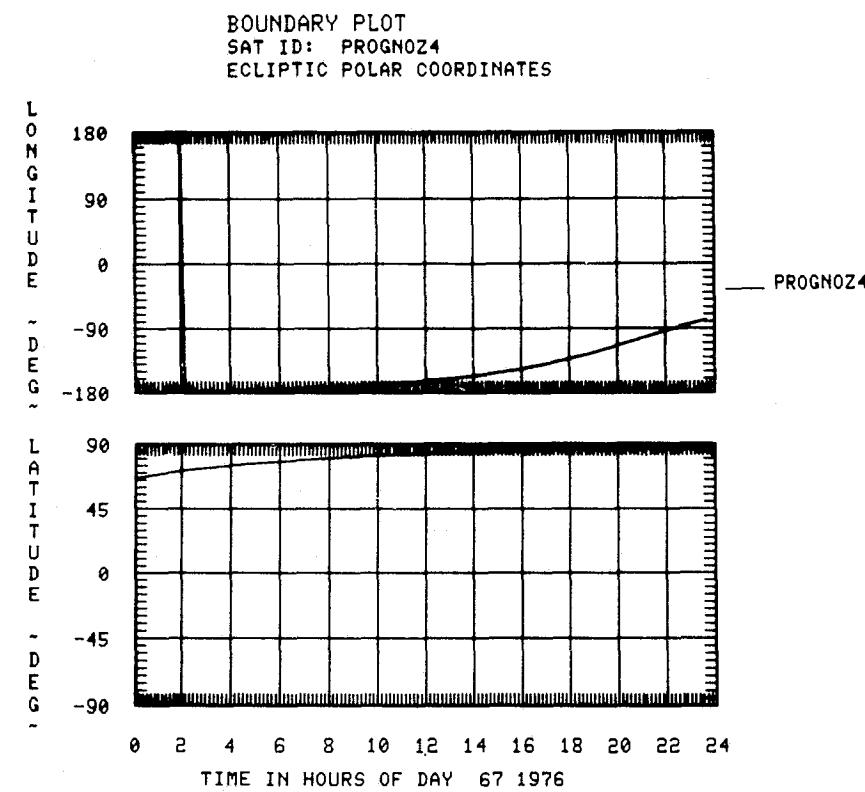
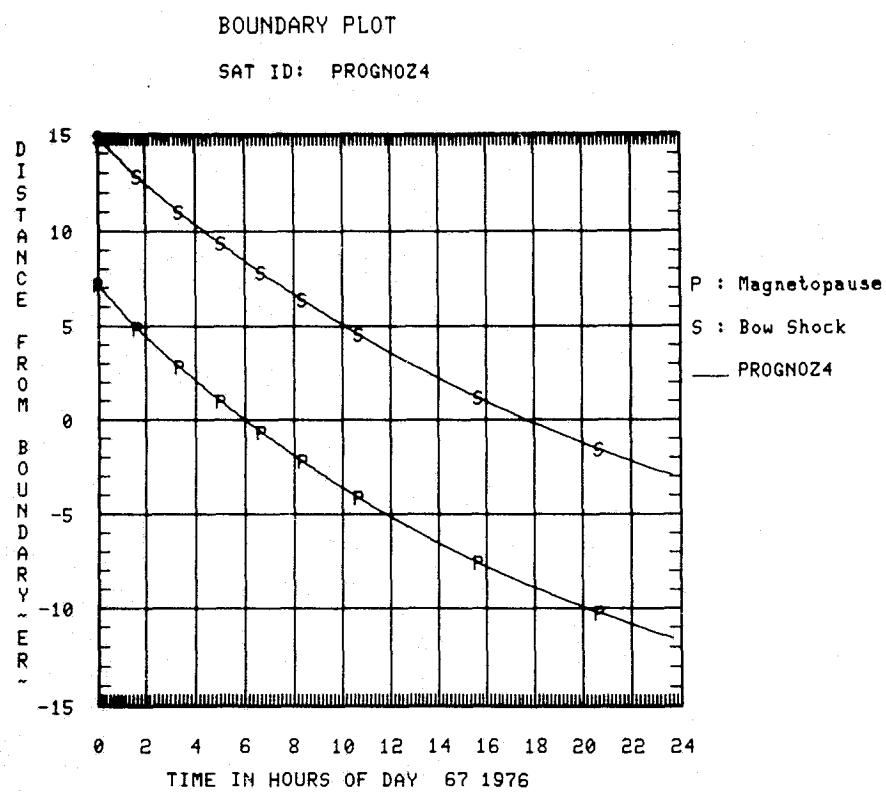
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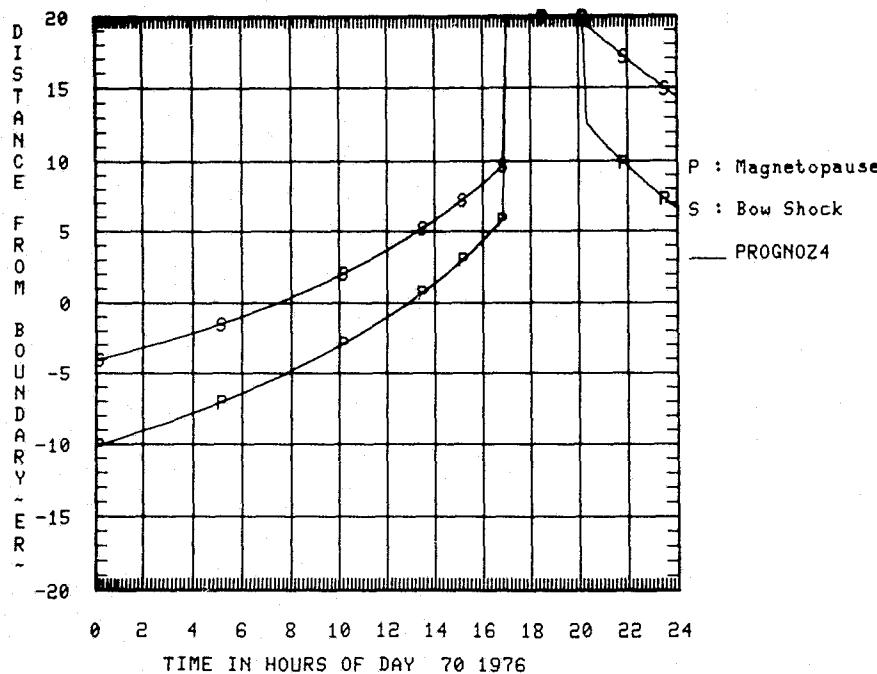
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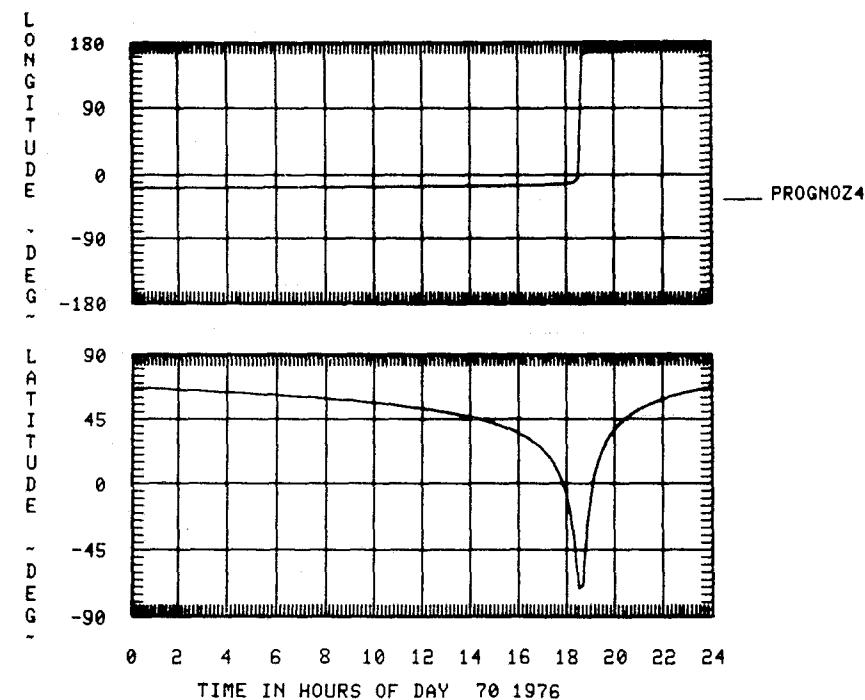
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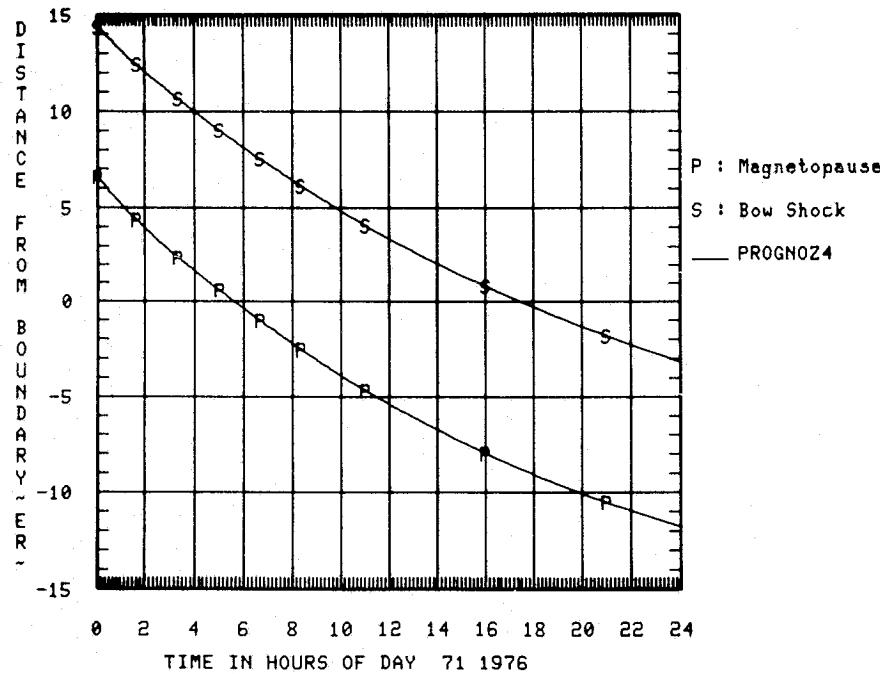
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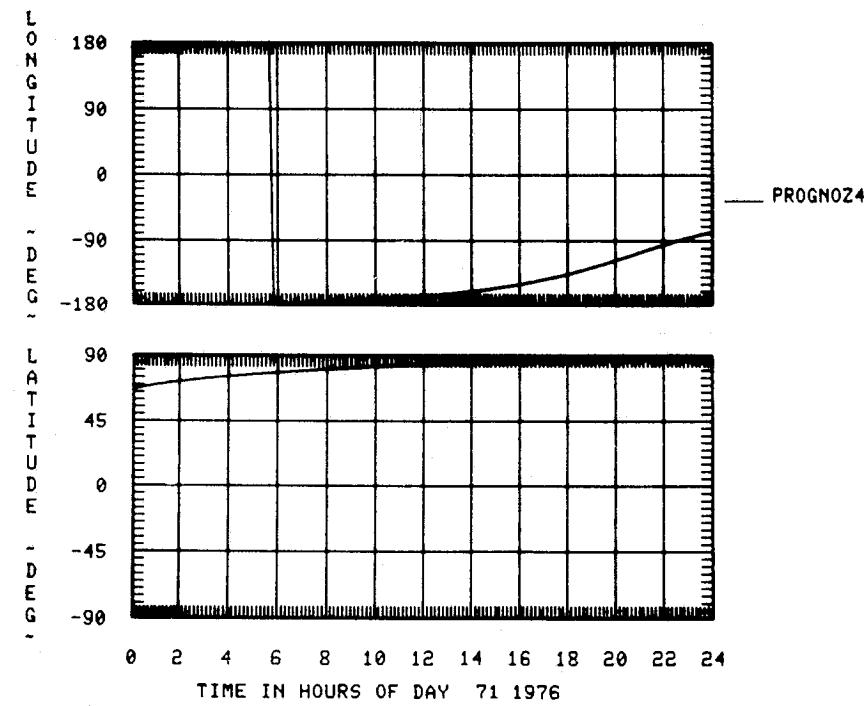


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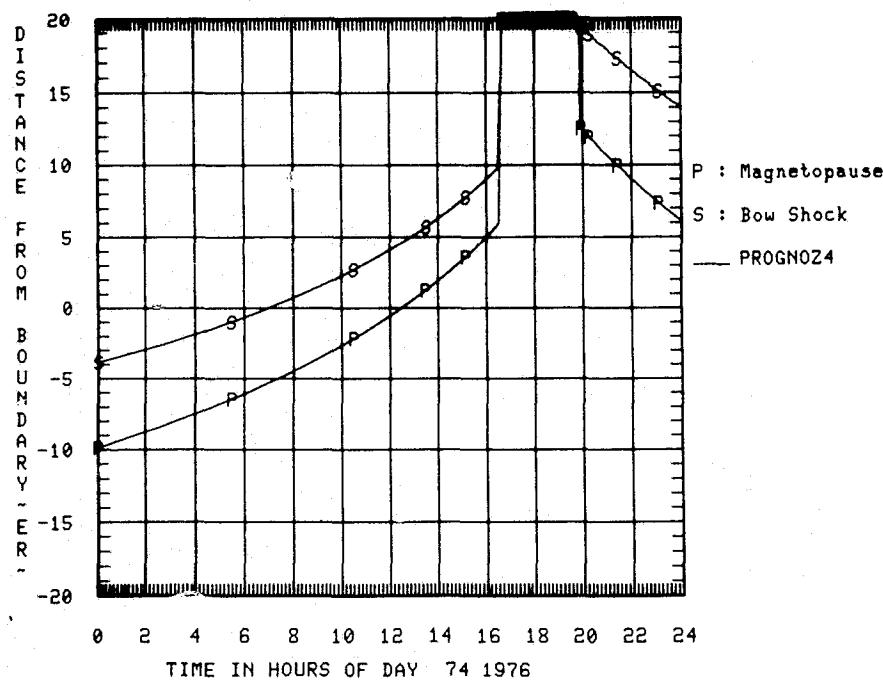


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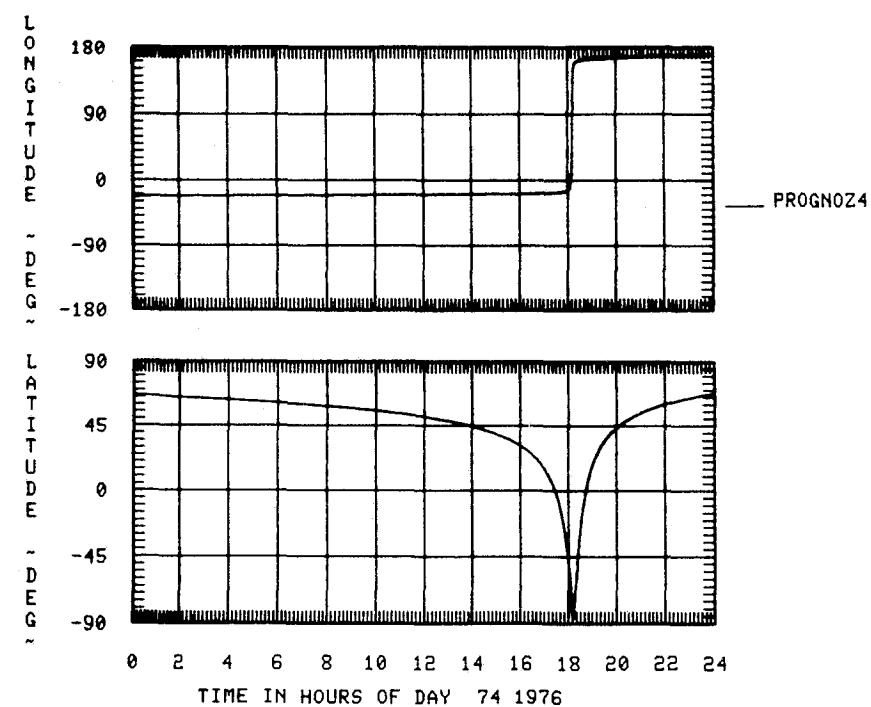
BOUNDARY PLOT

SAT ID: PROGNO24



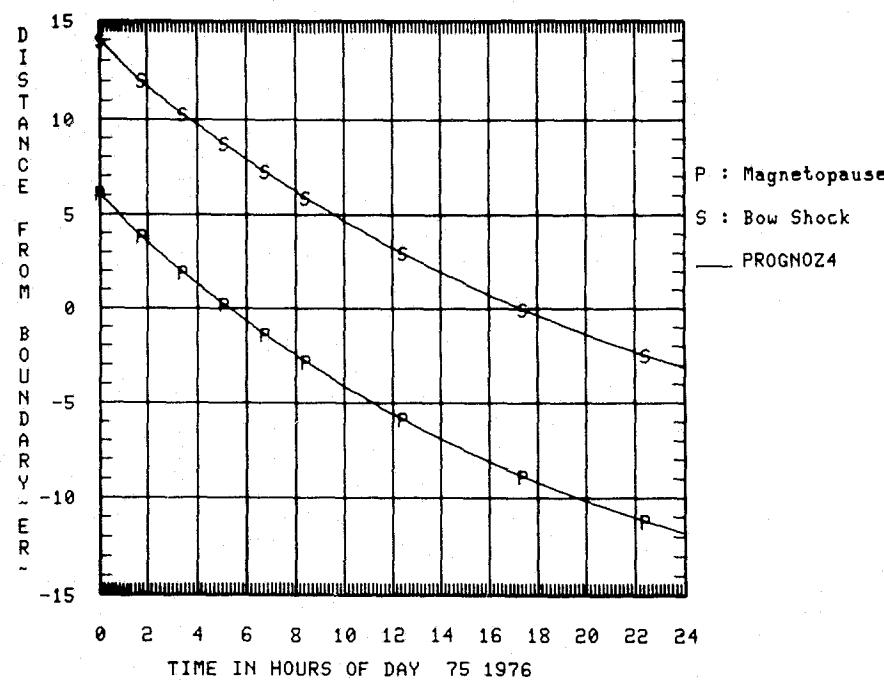
BOUNDARY PLOT

SAT ID: PROGNO24  
ECLIPTIC POLAR COORDINATES

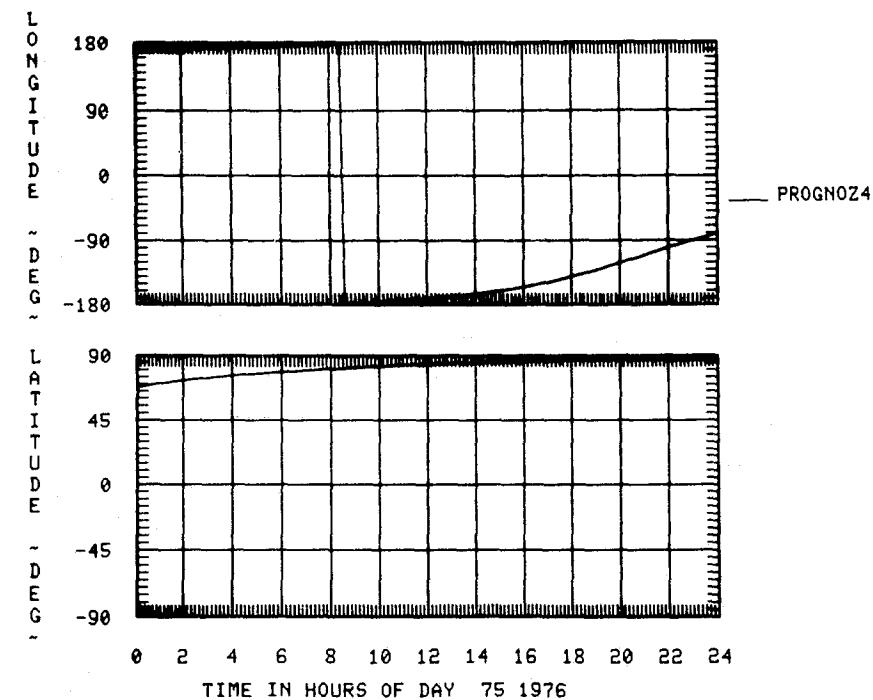


BOUNDARY PLOT

SAT ID: PROGNOZ4

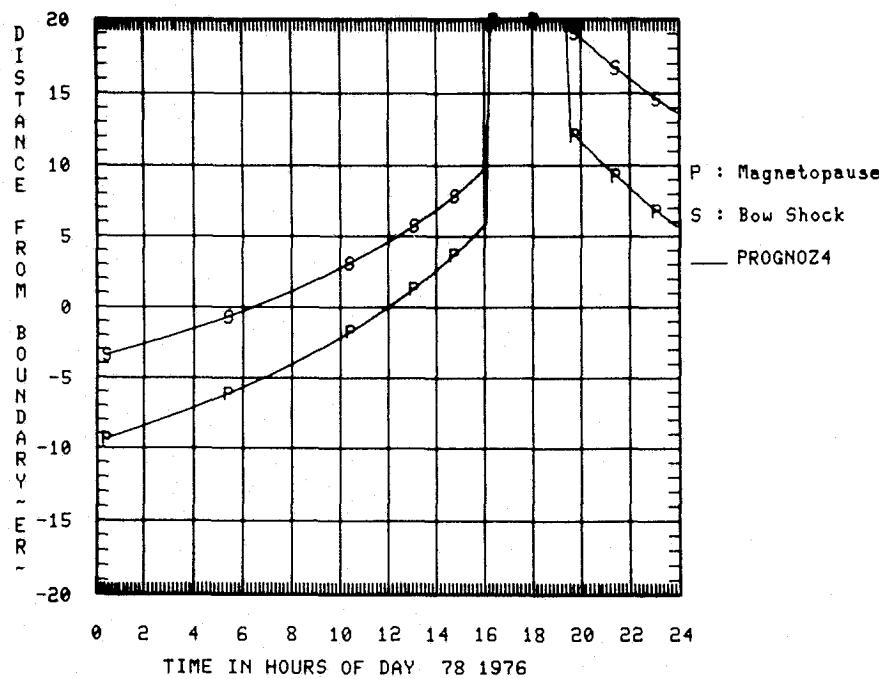


BOUNDARY PLOT  
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ECLIPTIC POLAR COORDINATES

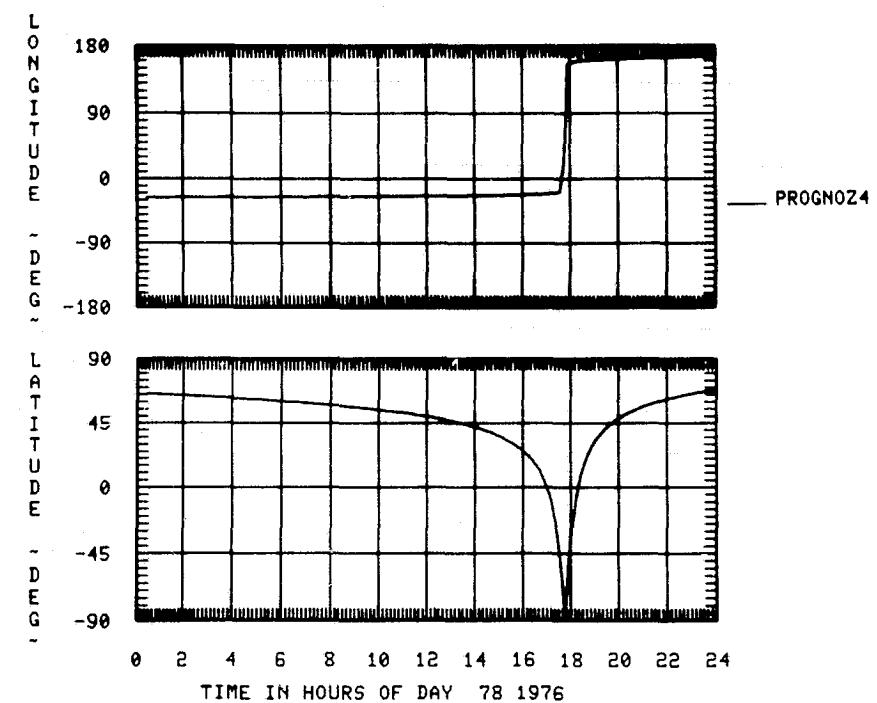


BOUNDARY PLOT

SAT ID: PROGNOZ4

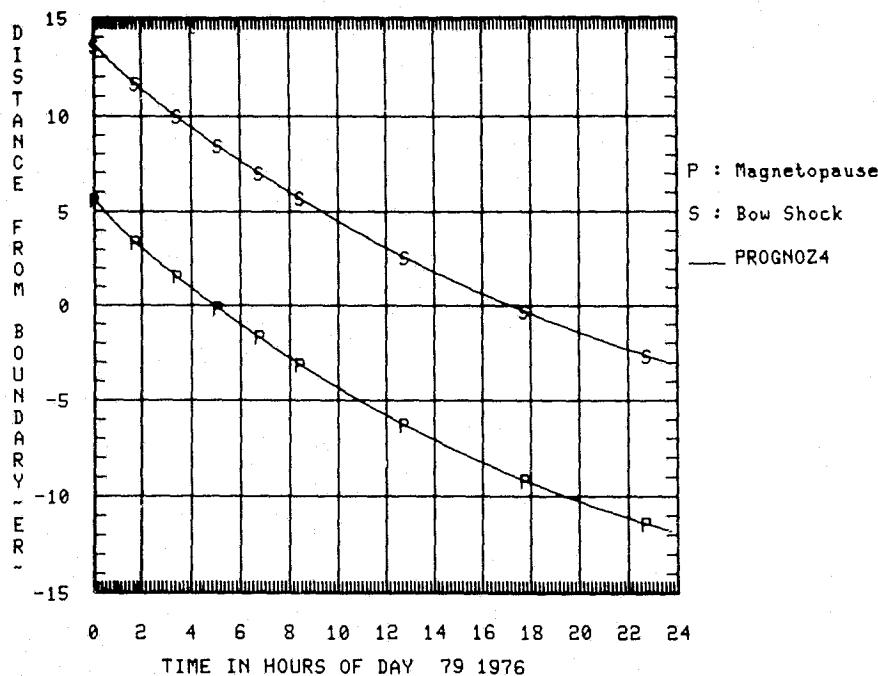


BOUNDARY PLOT  
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ECLIPTIC POLAR COORDINATES

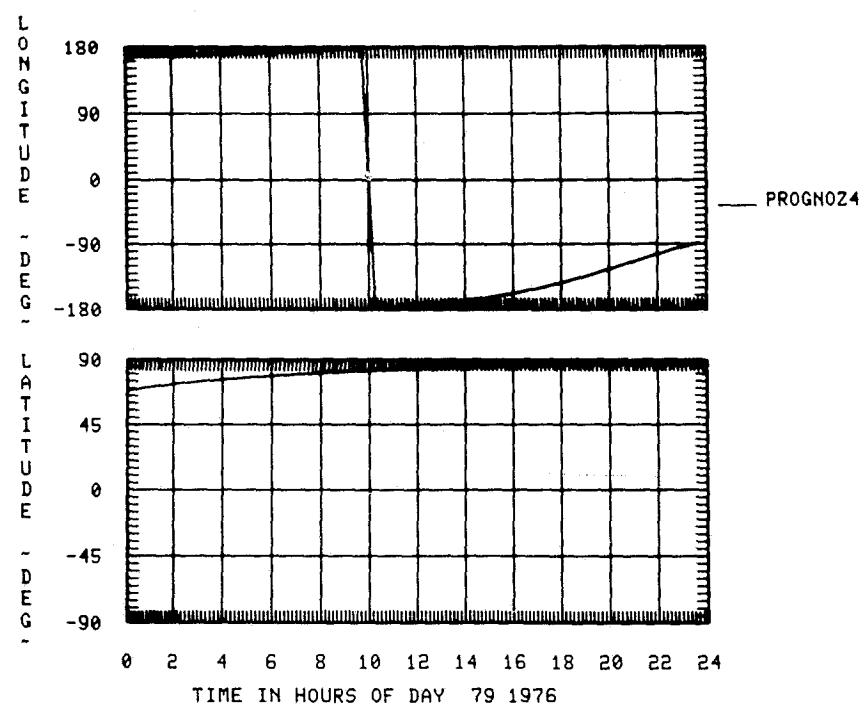


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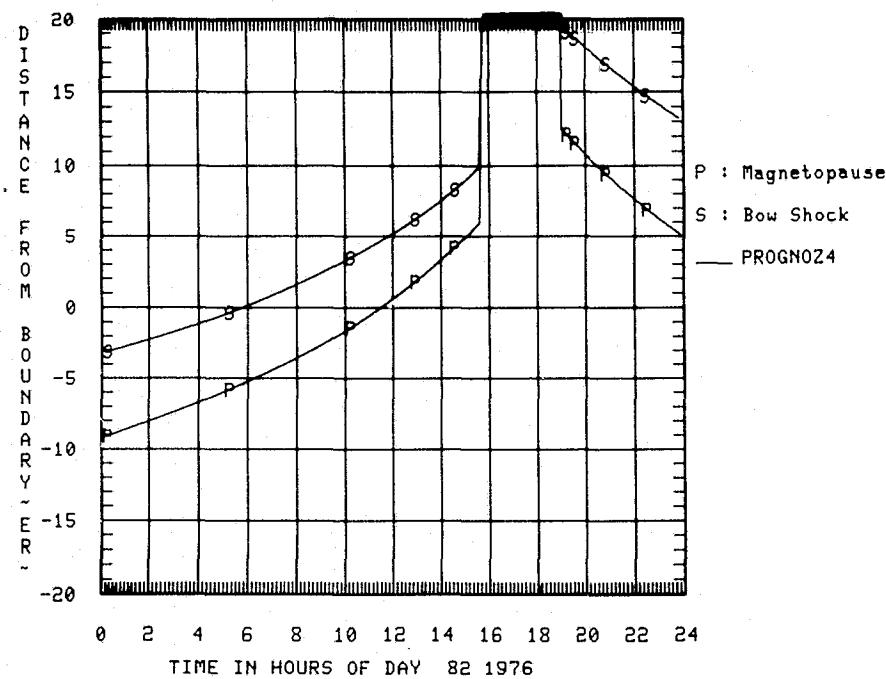


BOUNDARY PLOT  
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ECLIPTIC POLAR COORDINATES

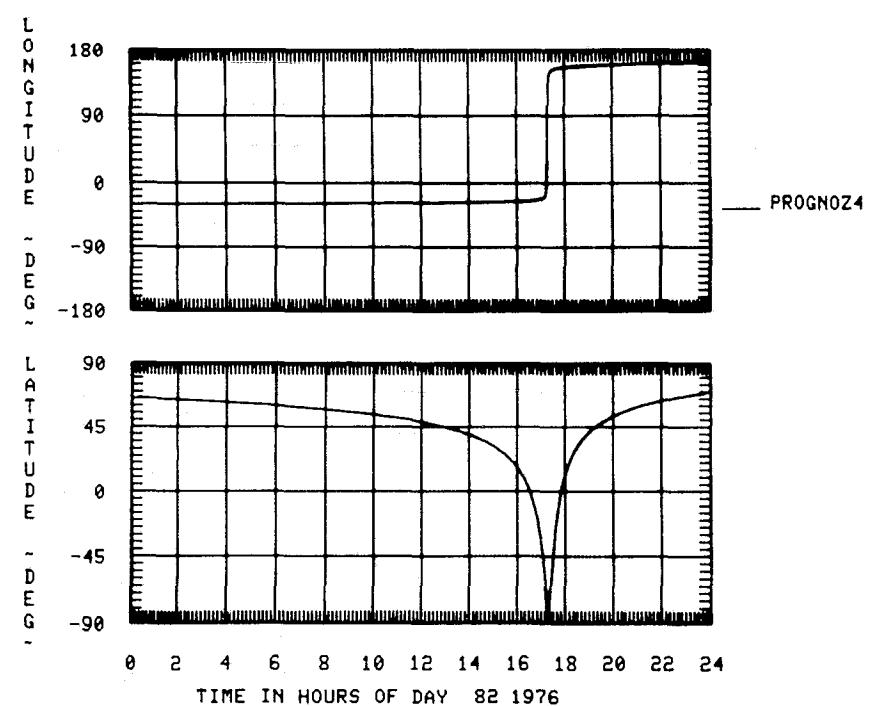


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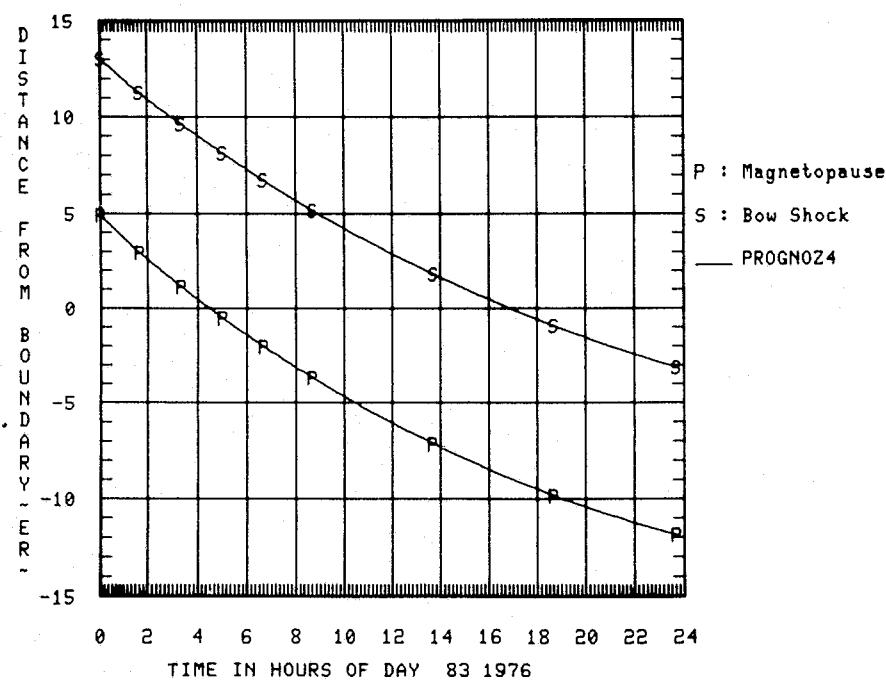


BOUNDARY PLOT  
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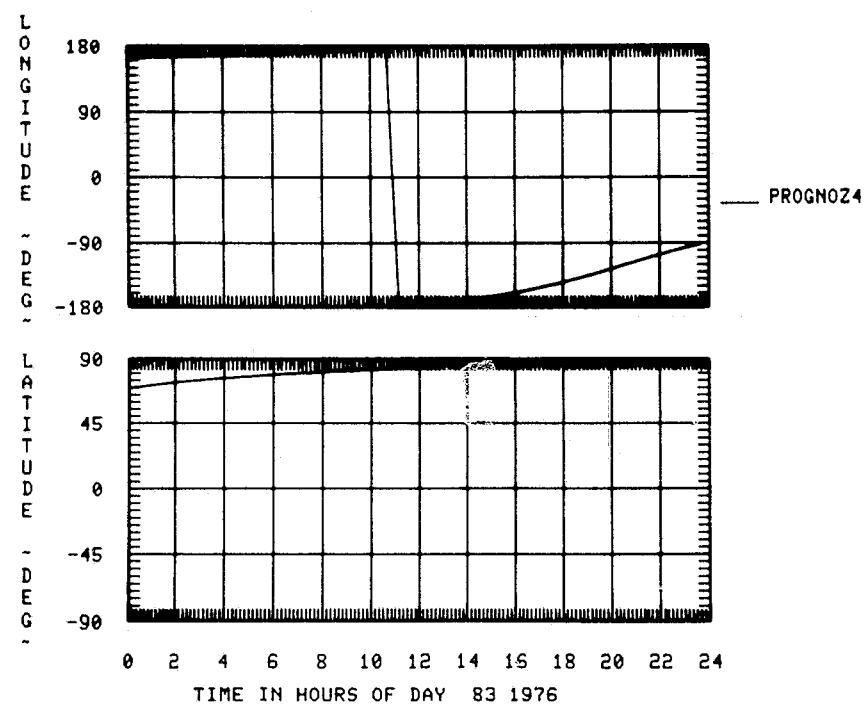


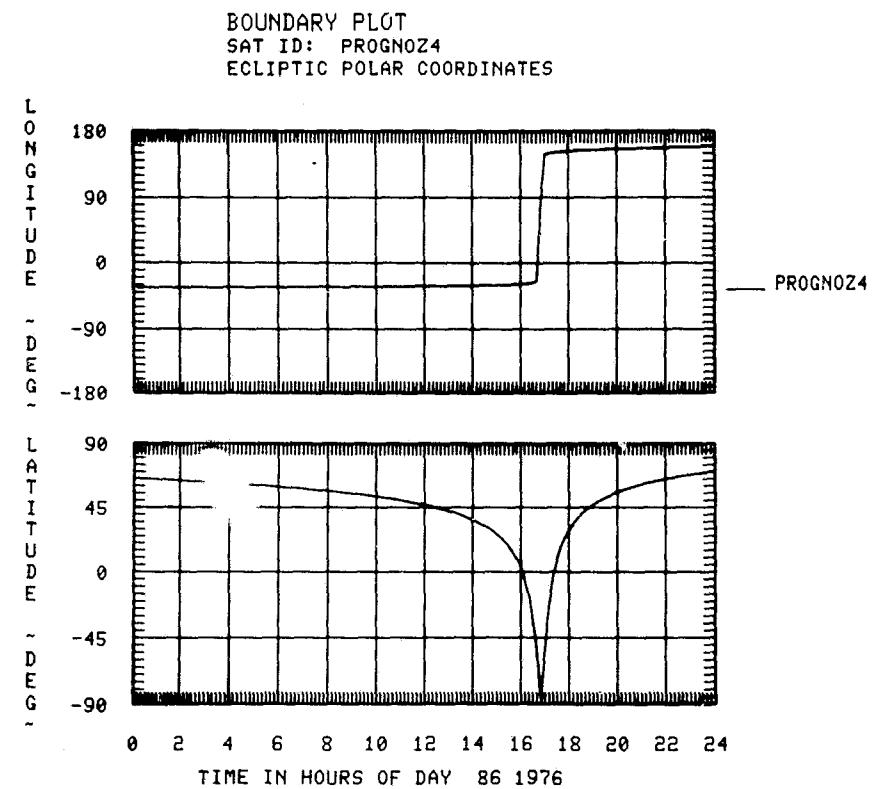
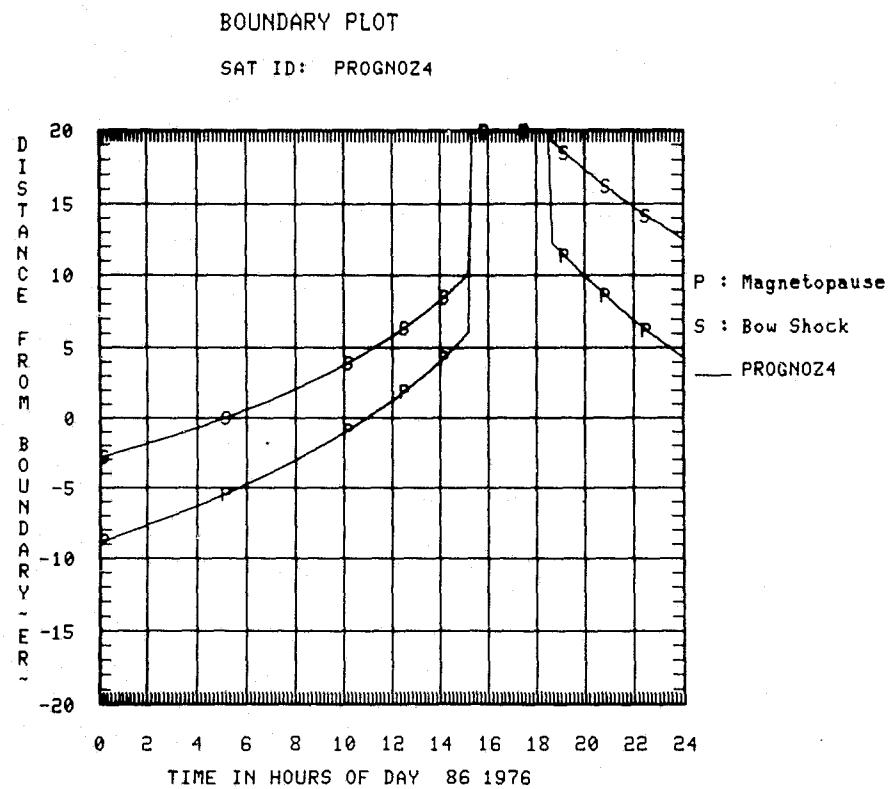
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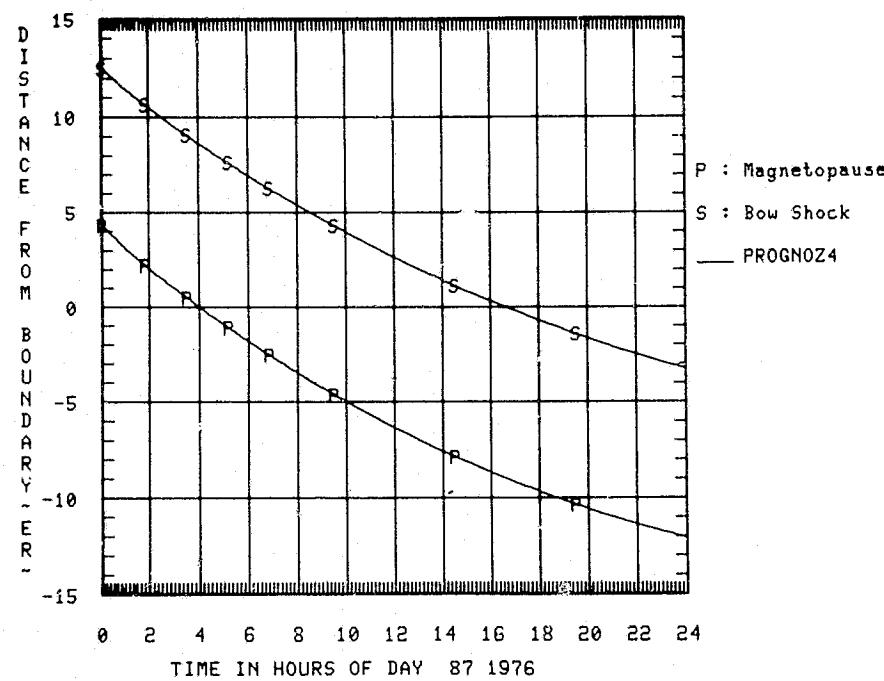


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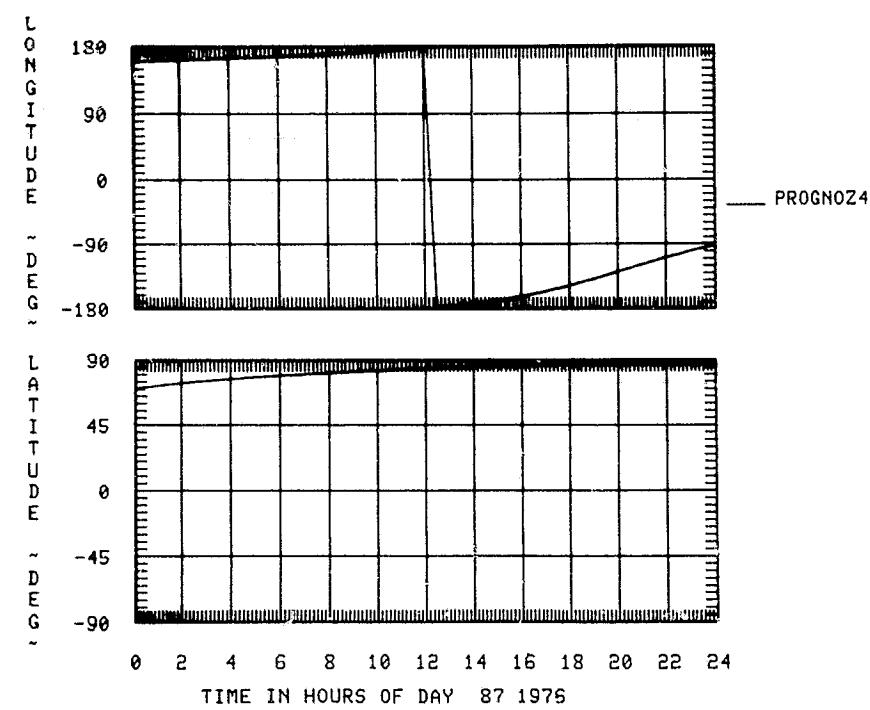




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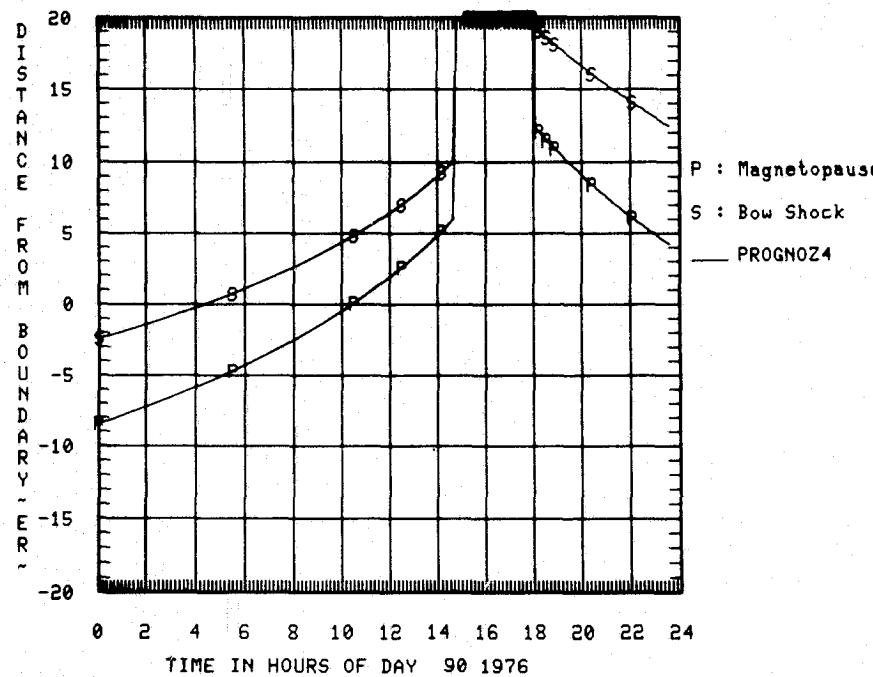


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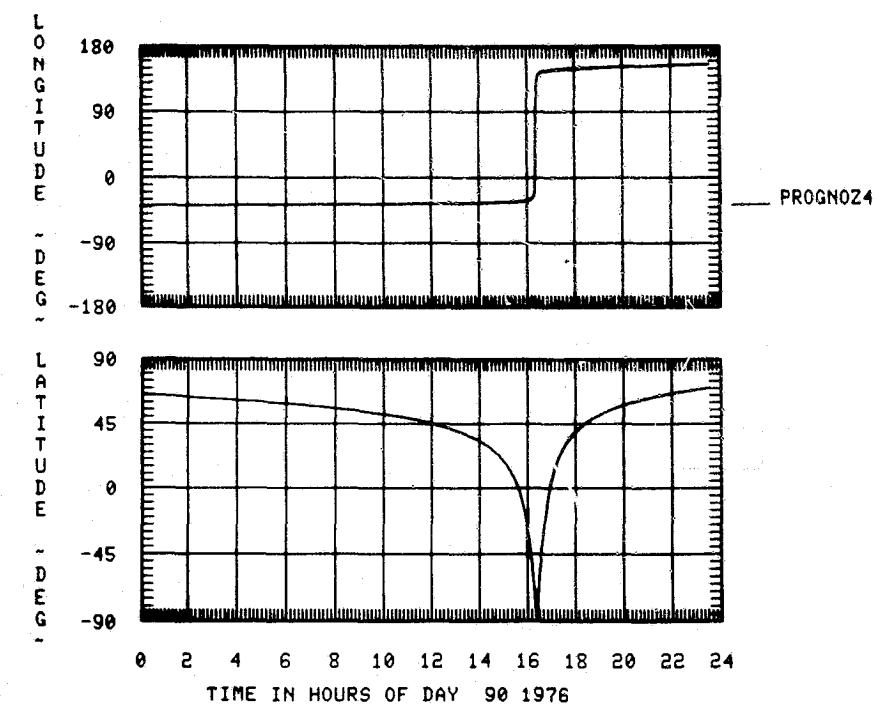
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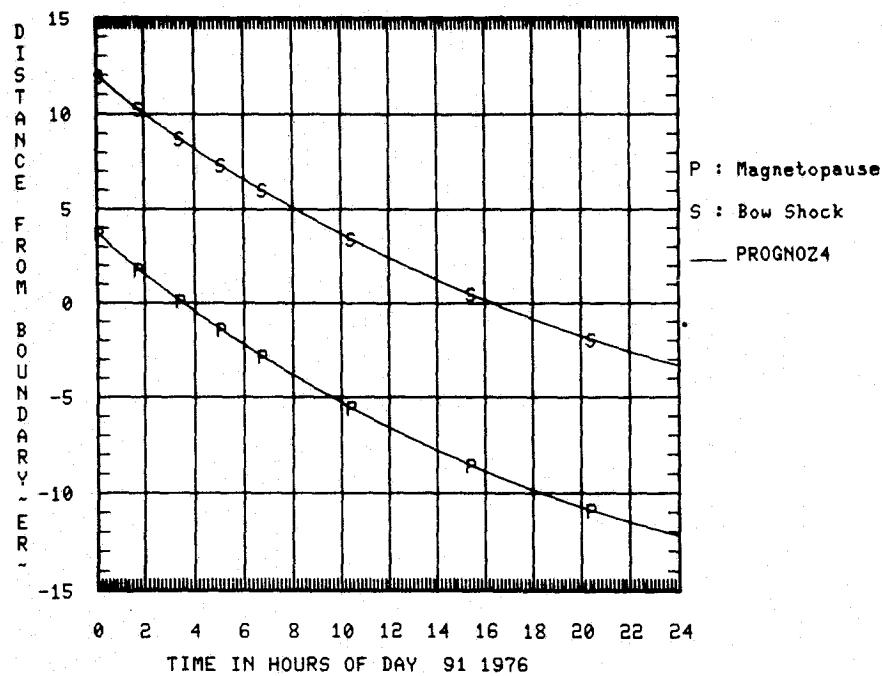
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ECLIPTIC POLAR COORDINATES



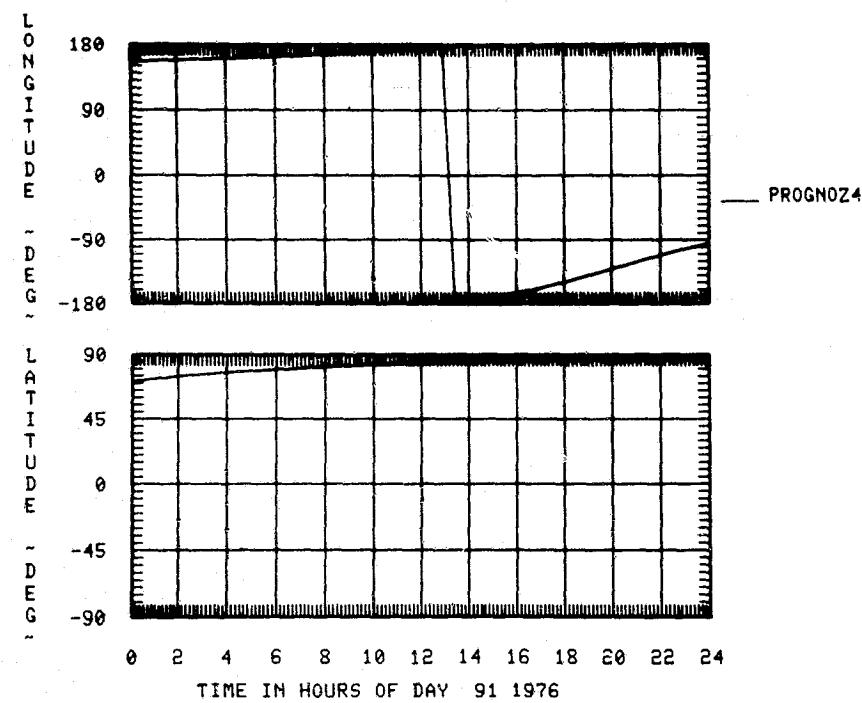
### BOUNDARY PLOT

SAT ID: PROGNOZ4



### BOUNDARY PLOT

SAT ID: PROGNOZ4  
ECLIPTIC POLAR COORDINATES



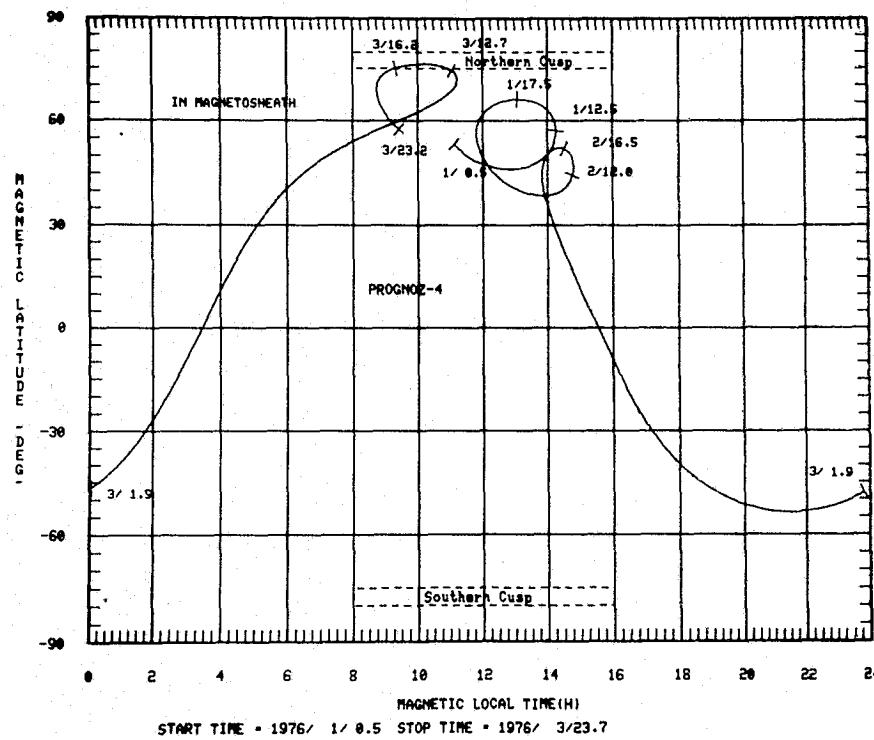
**APPENDIX D**

**SOLAR MAGNETIC LATITUDE**

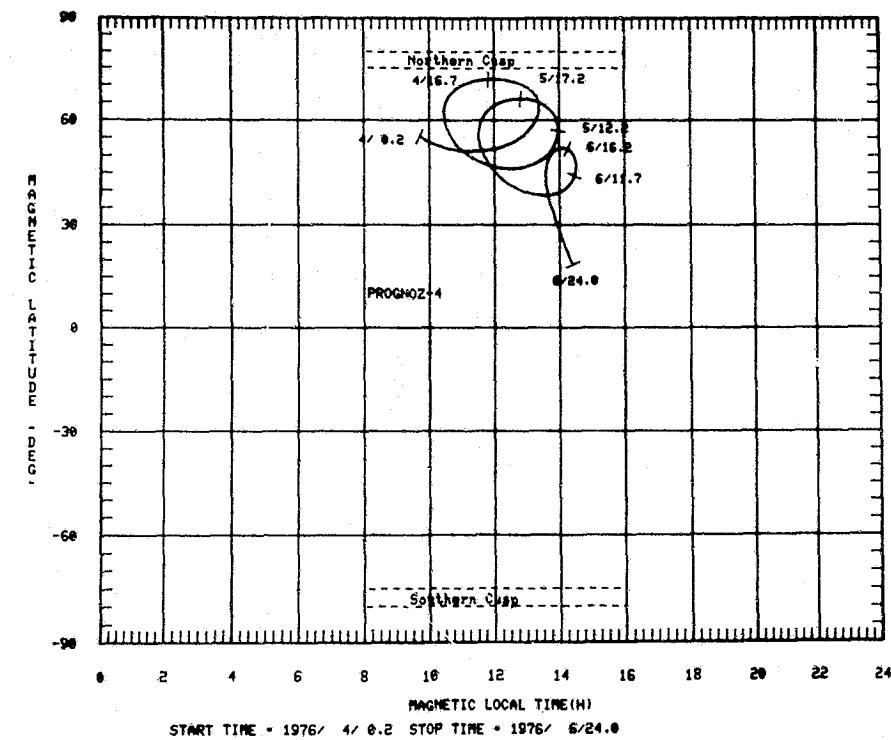
**VERSUS**

**LOCAL TIME PLOTS**

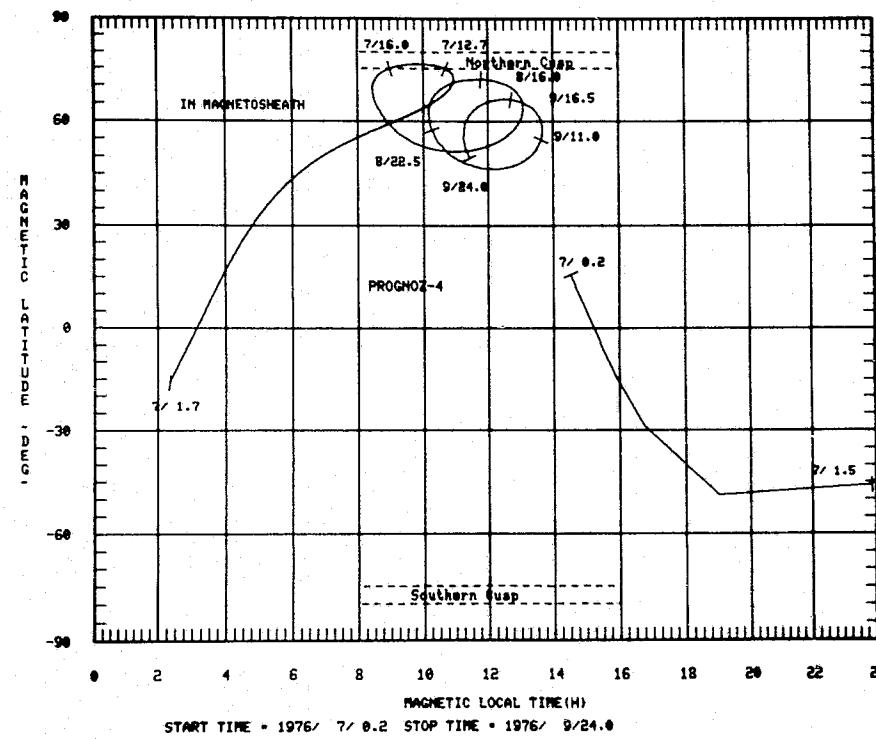
MAGNETIC LATITUDE-MAGNETIC LOCAL TIME PROJECTION



MAGNETIC LATITUDE-MAGNETIC LOCAL TIME PROJECTION

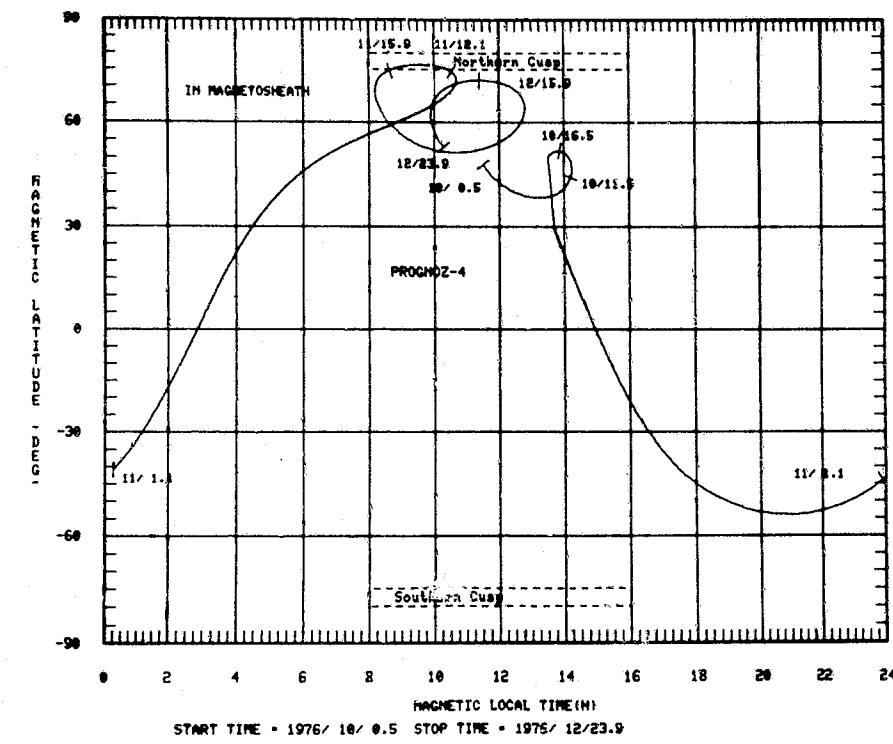


MAGNETIC LATITUDE-MAGNETIC LOCAL TIME PROJECTION



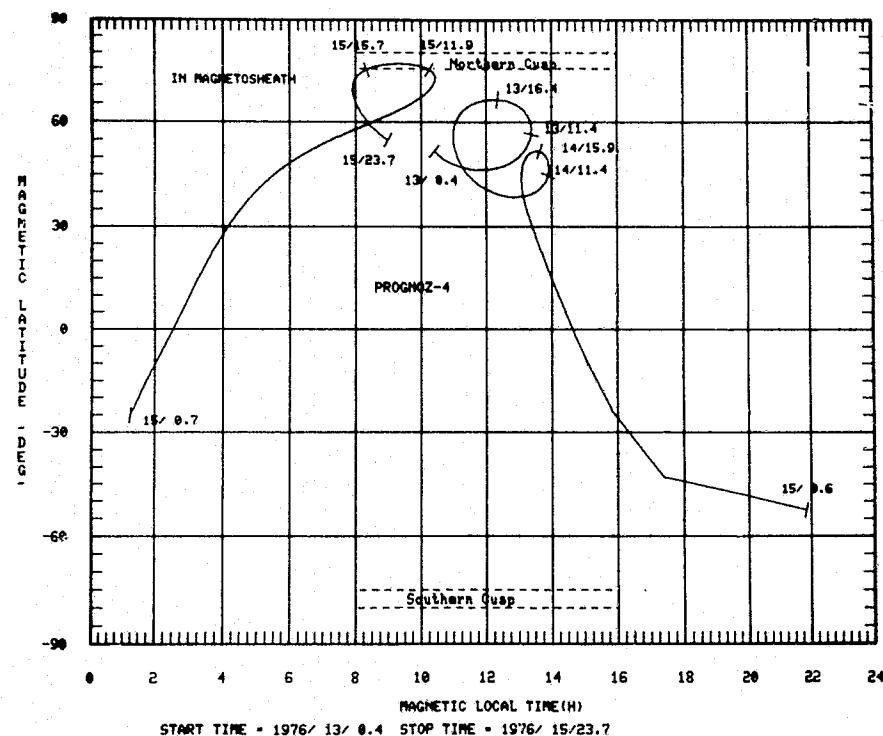
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MAGNETIC LATITUDE-MAGNETIC LOCAL TIME PROJECTION

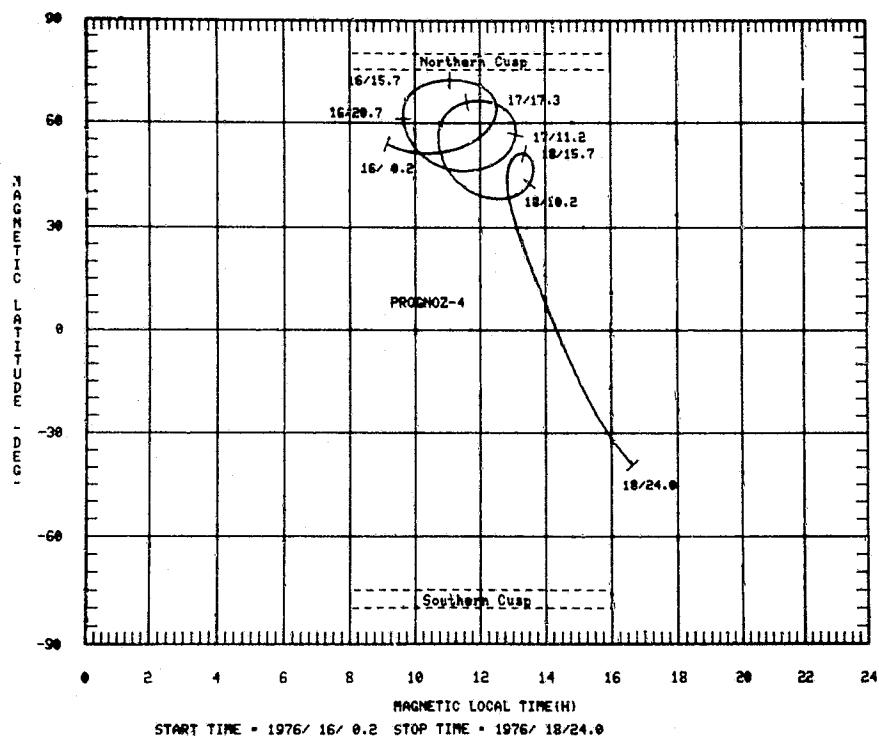


START TIME = 1976/ 10/ 0.5 STOP TIME = 1976/ 12/23.0

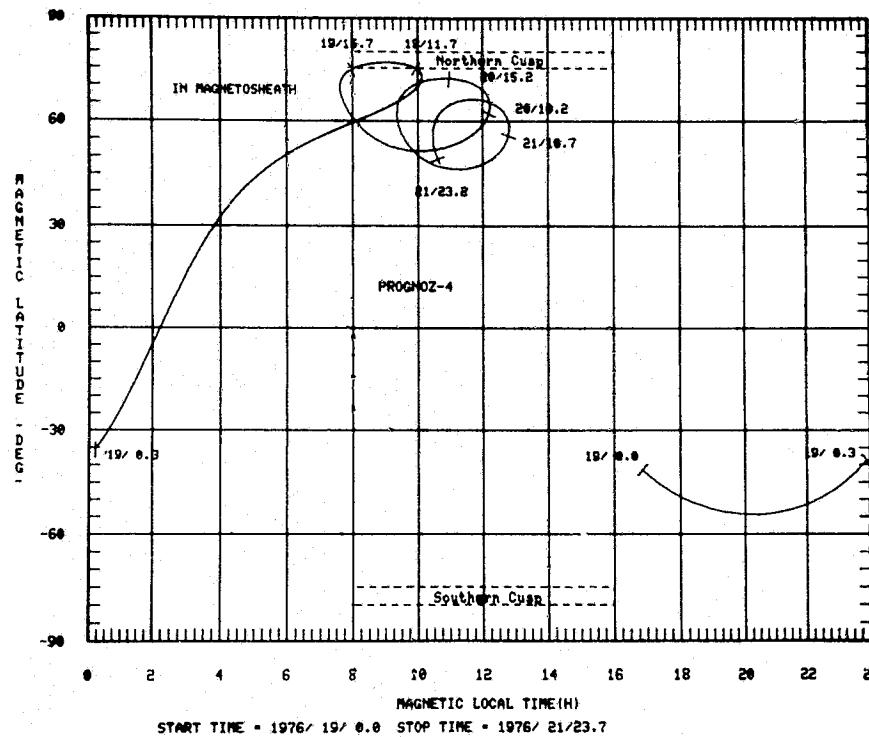
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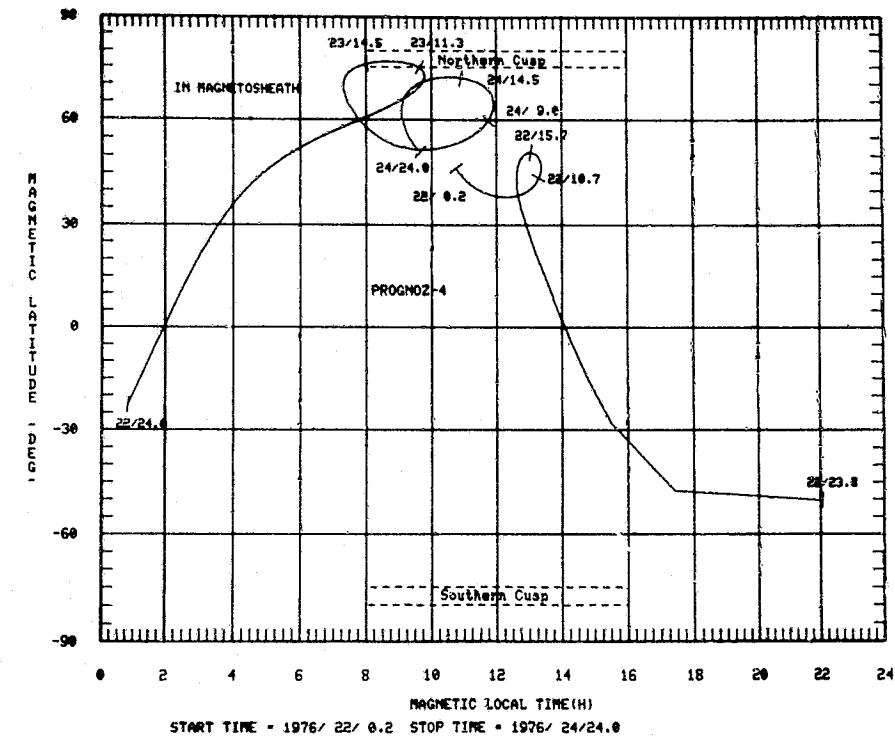
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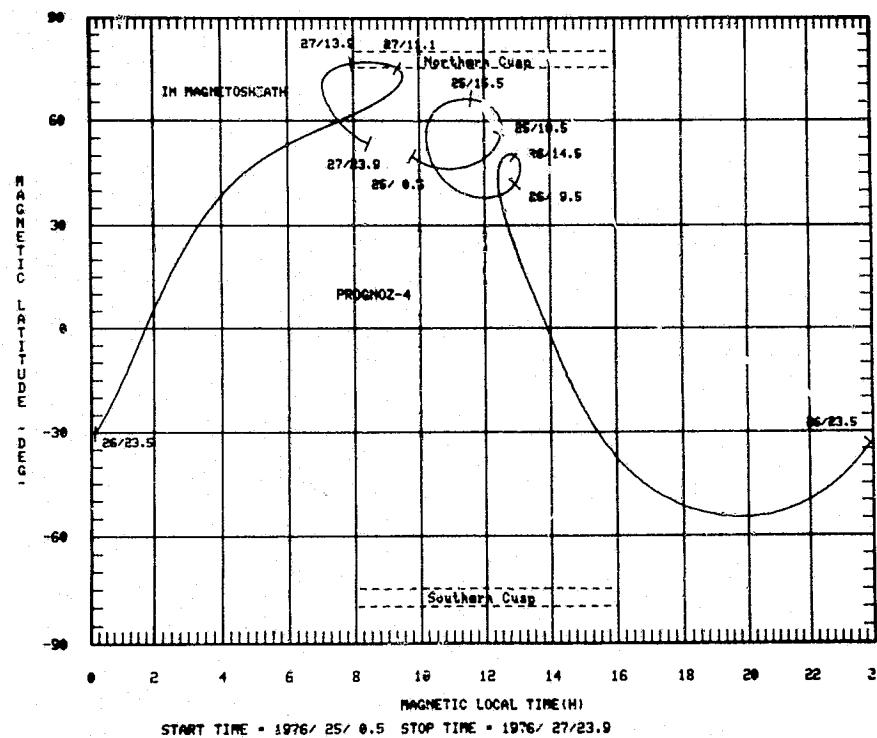
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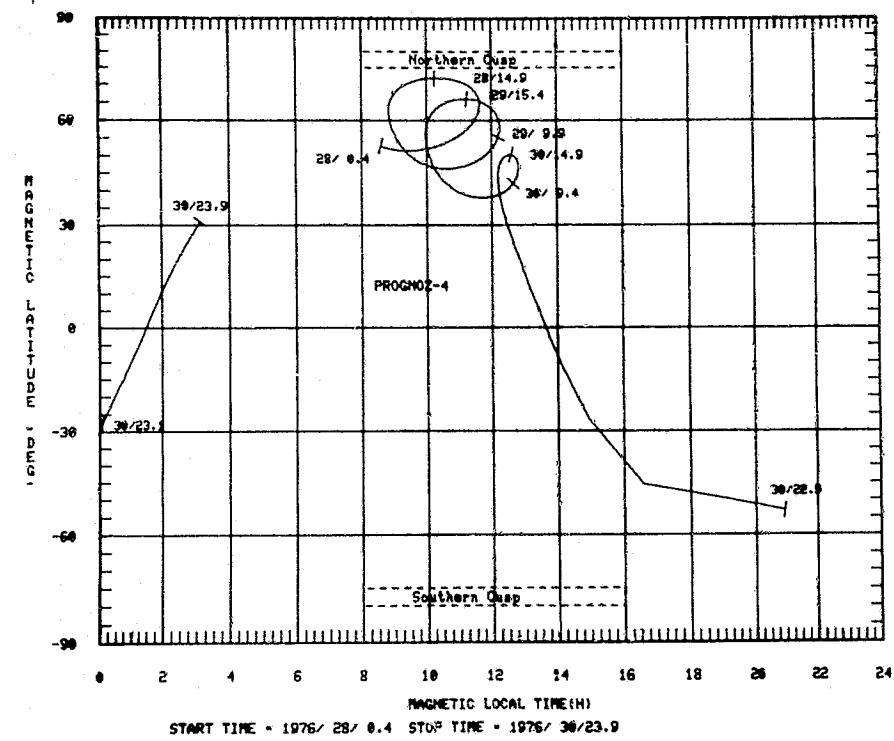
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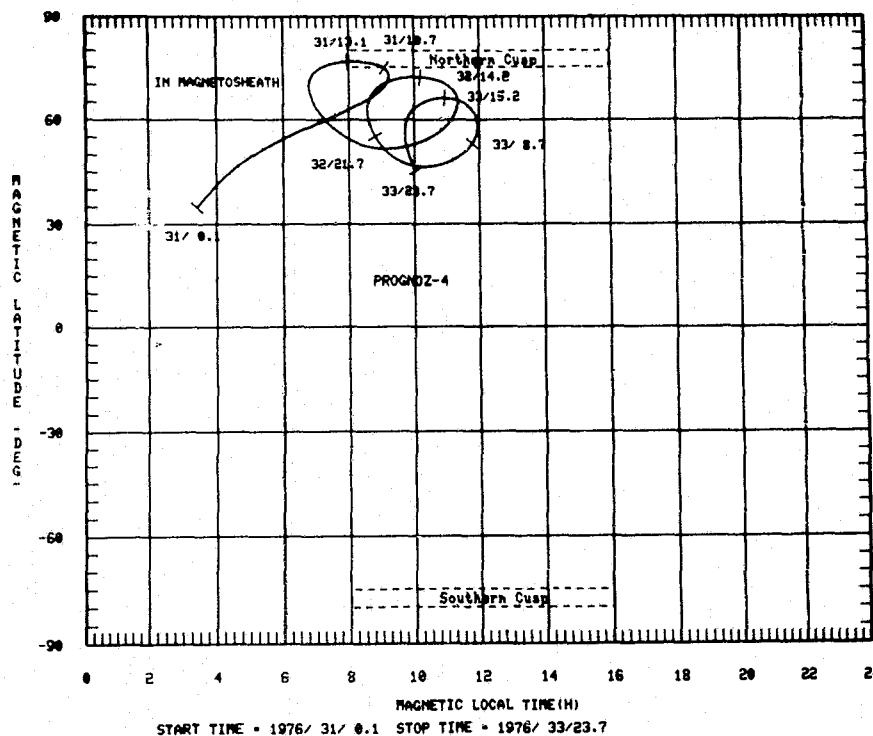
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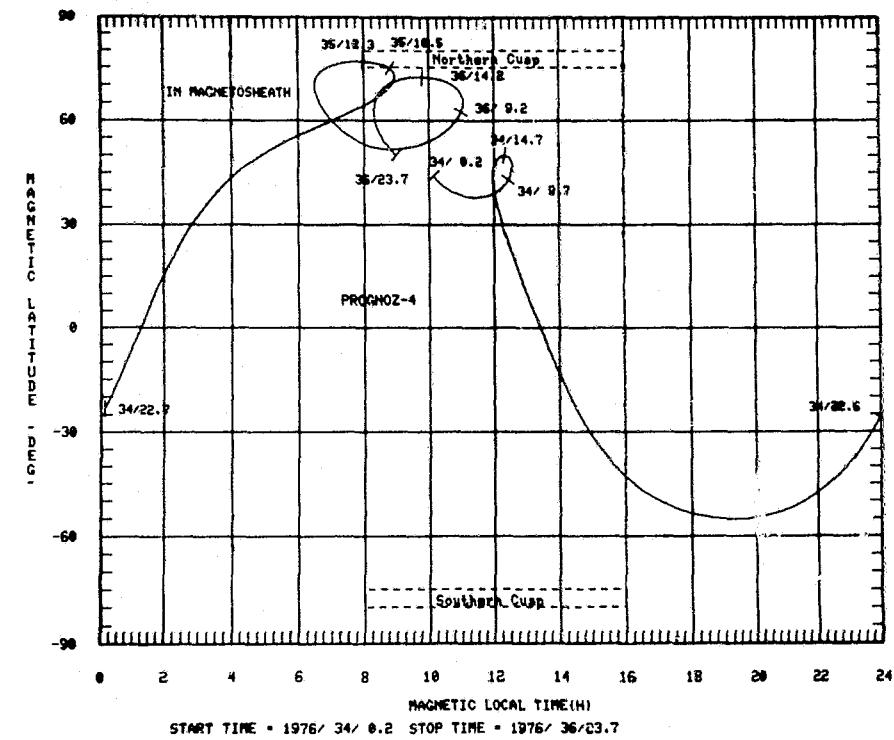
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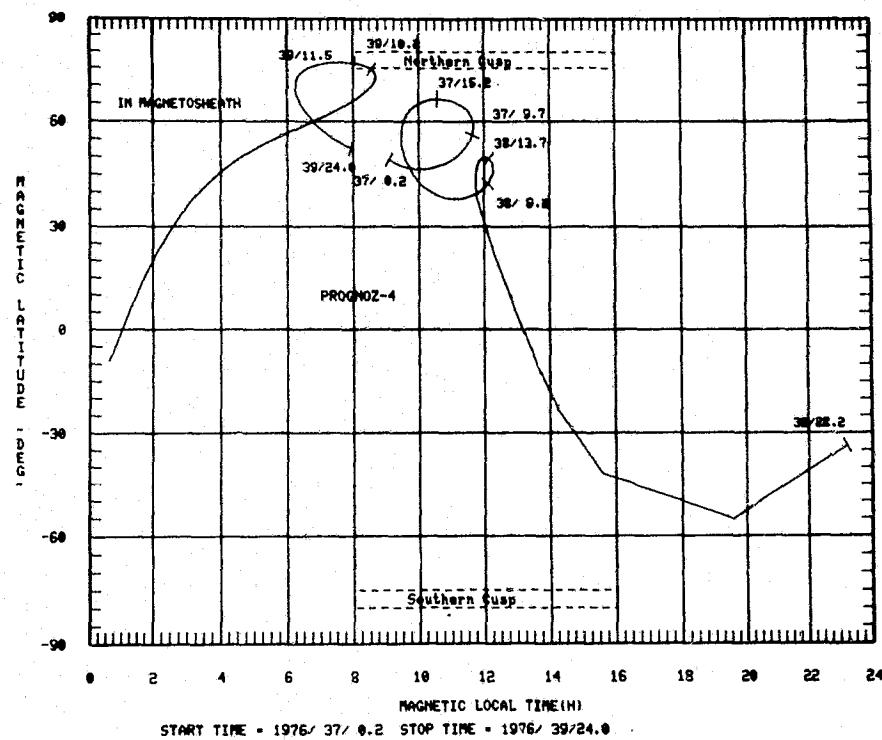
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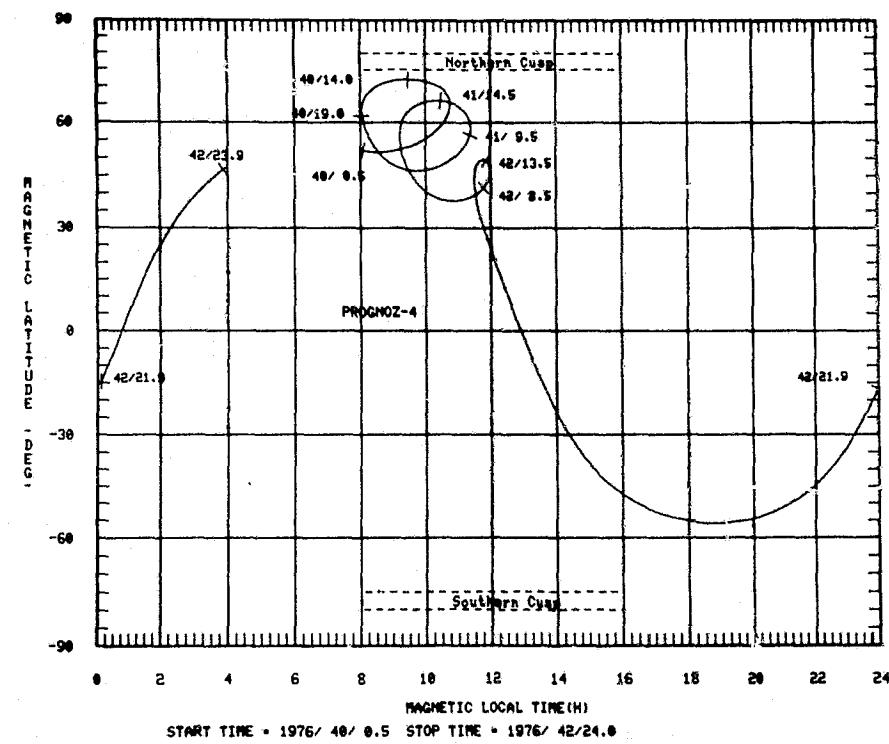
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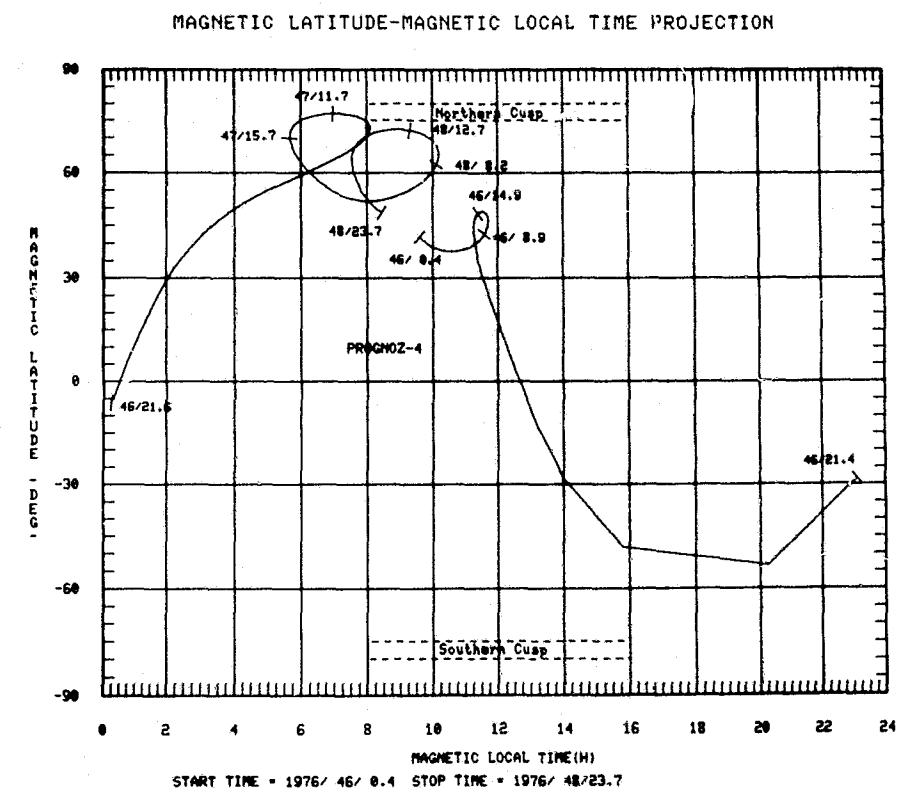
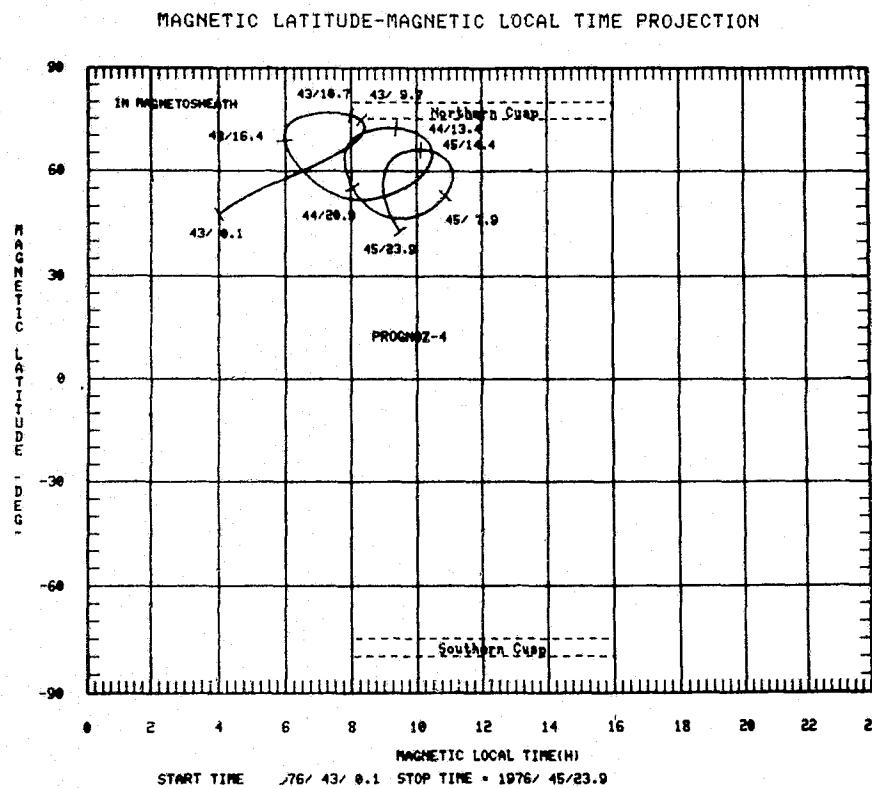


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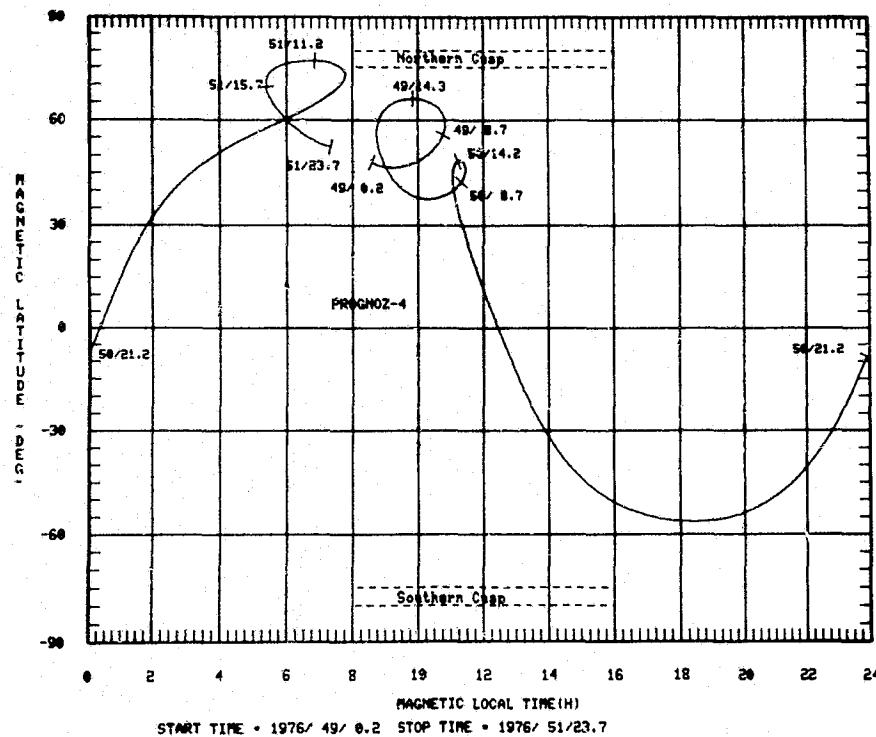


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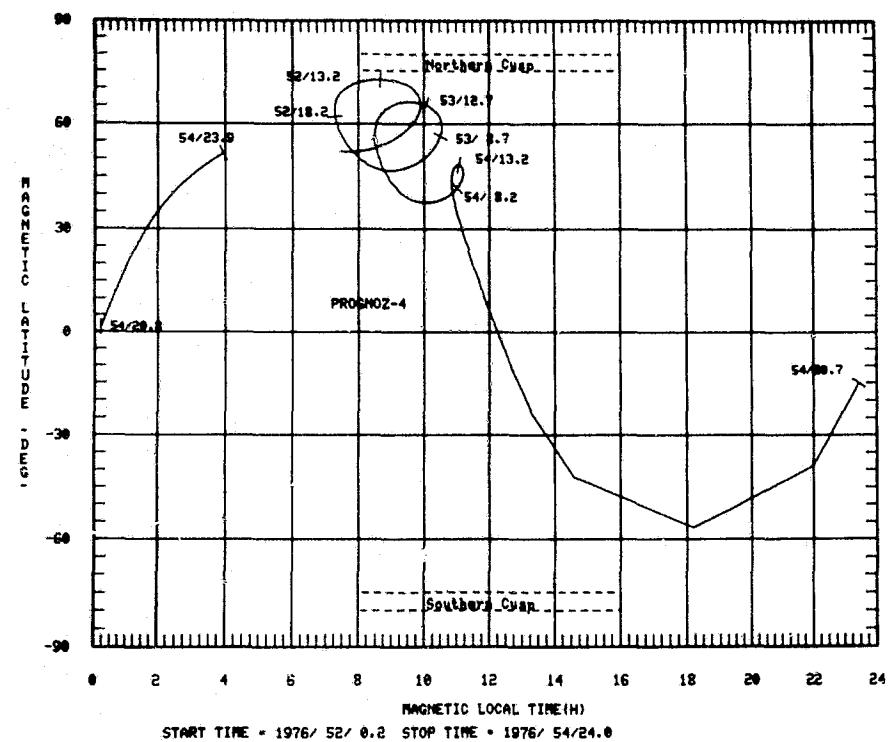




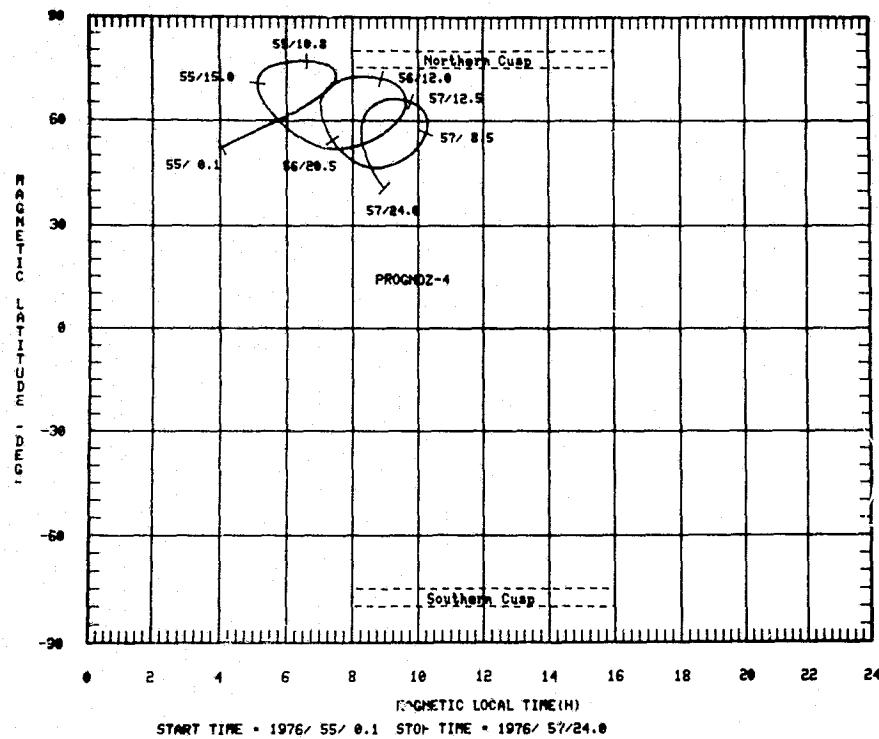
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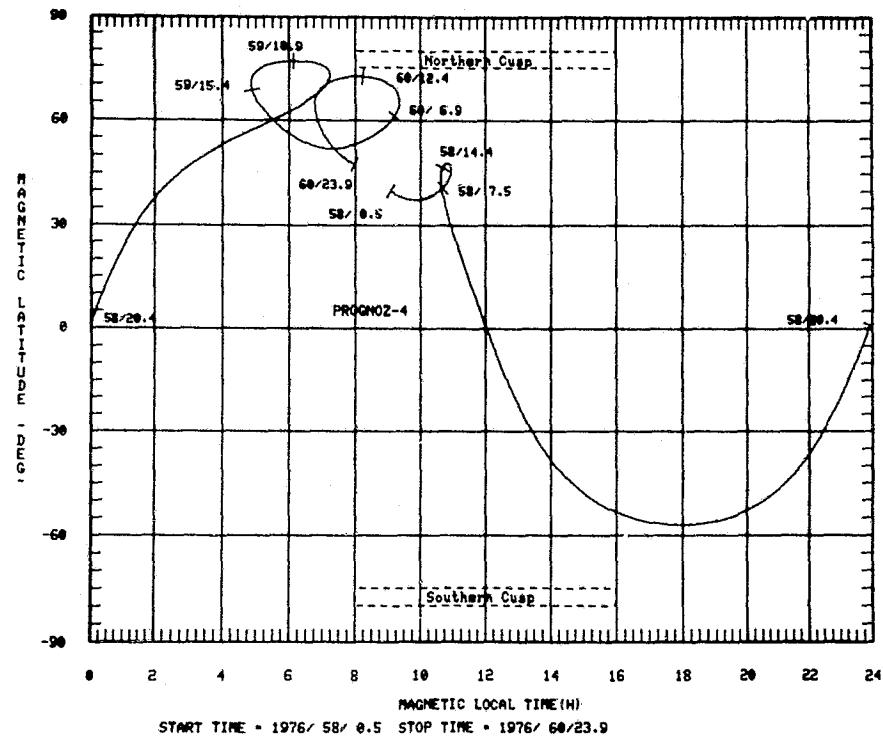
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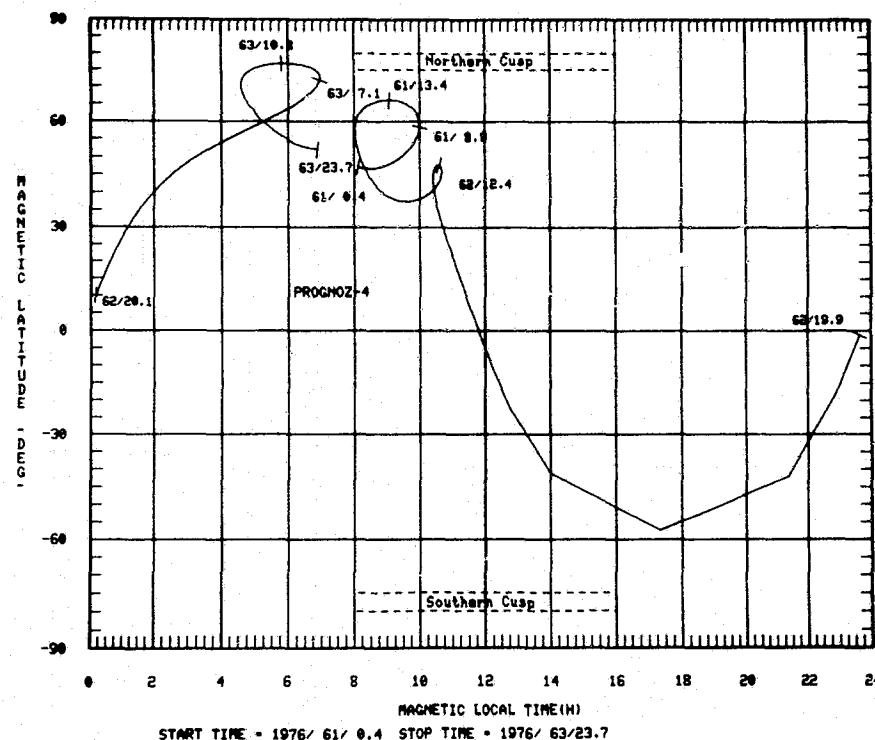
MAGNETIC LATITUDE-MAGNETIC LOCAL TIME PROJECTION



MAGNETIC LATITUDE-MAGNETIC LOCAL TIME PROJECTION

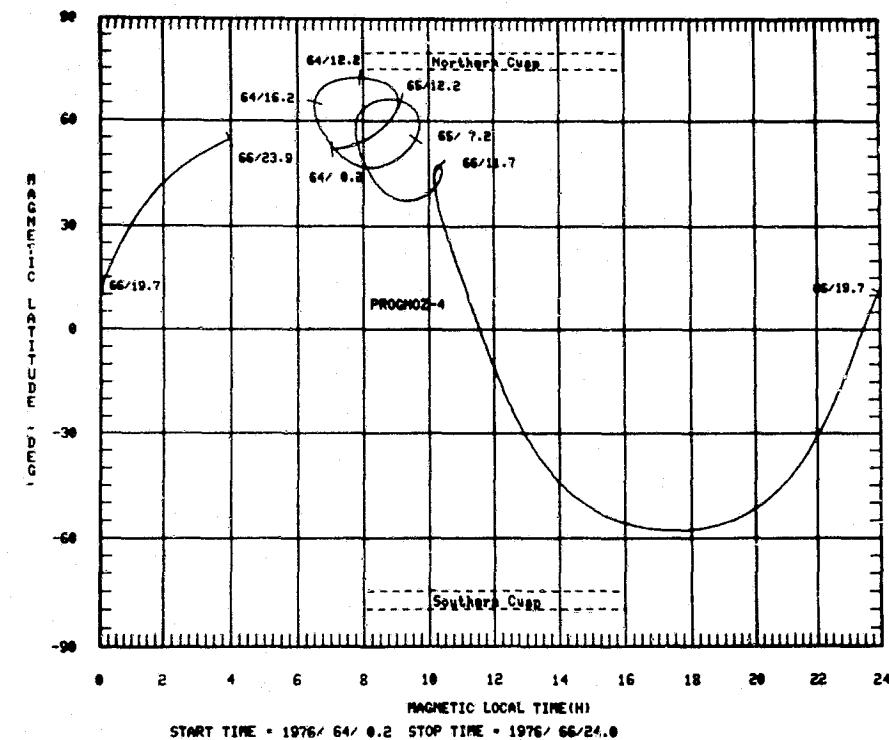


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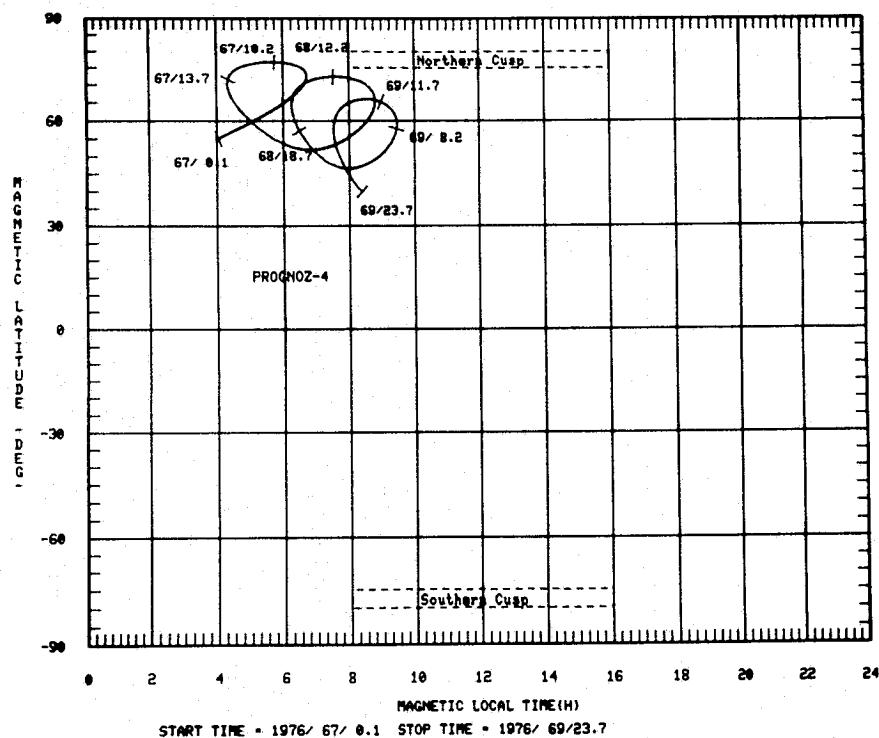
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START TIME = 1976/ 61/ 0.4 STOP TIME = 1976/ 63/23.7

MAGNETIC LATITUDE-MAGNETIC LOCAL TIME PROJECTION

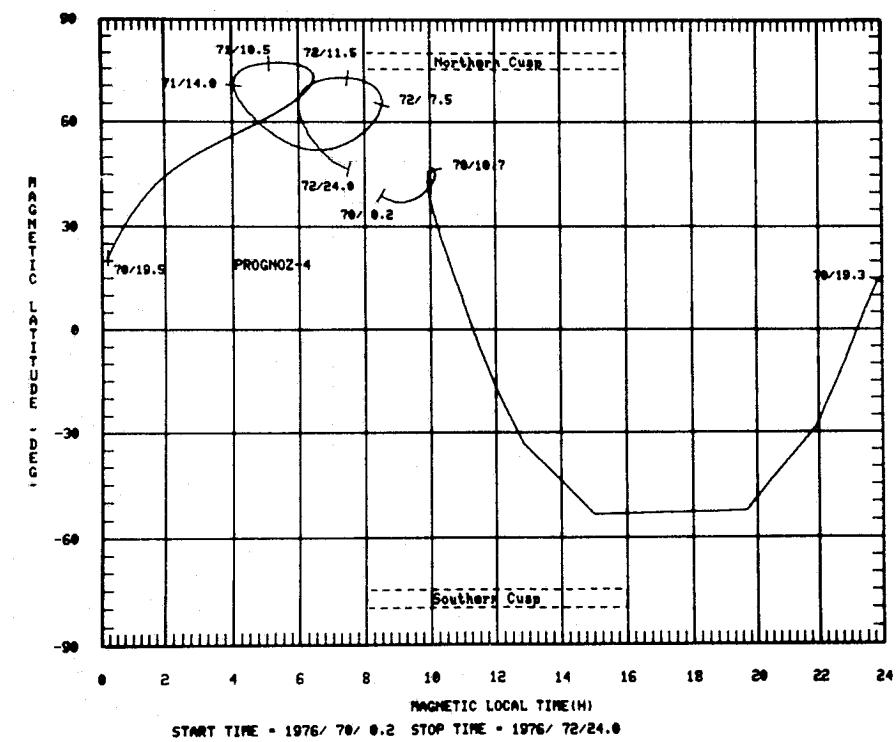


MAGNETIC LOCAL TIME(H)  
START TIME = 1976/ 64/ 0.2 STOP TIME = 1976/ 66/24.0

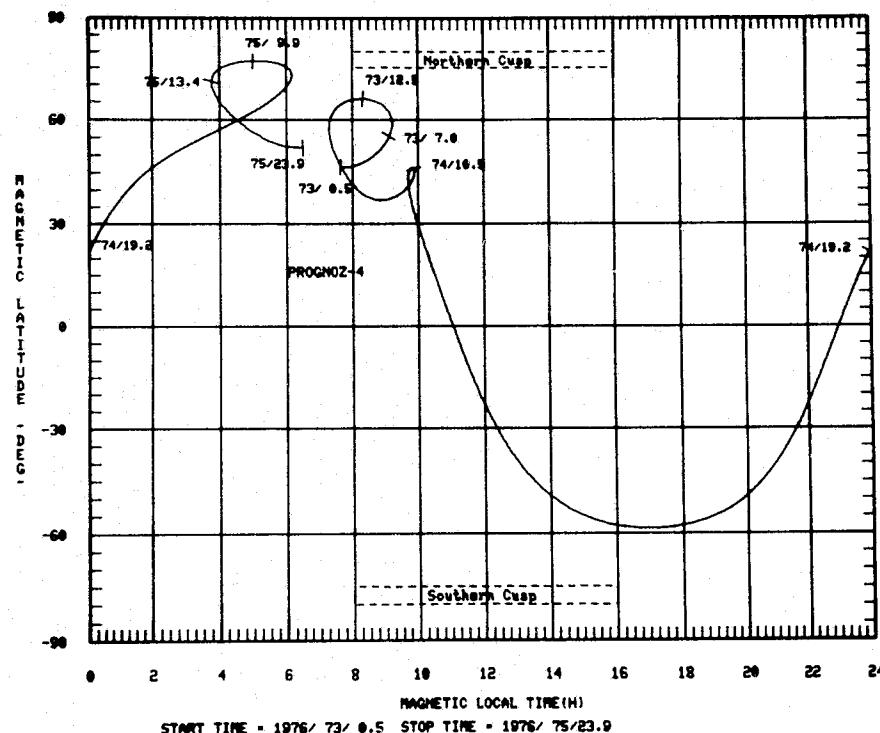
MAGNETIC LATITUDE-MAGNETIC LOCAL TIME PROJECTION



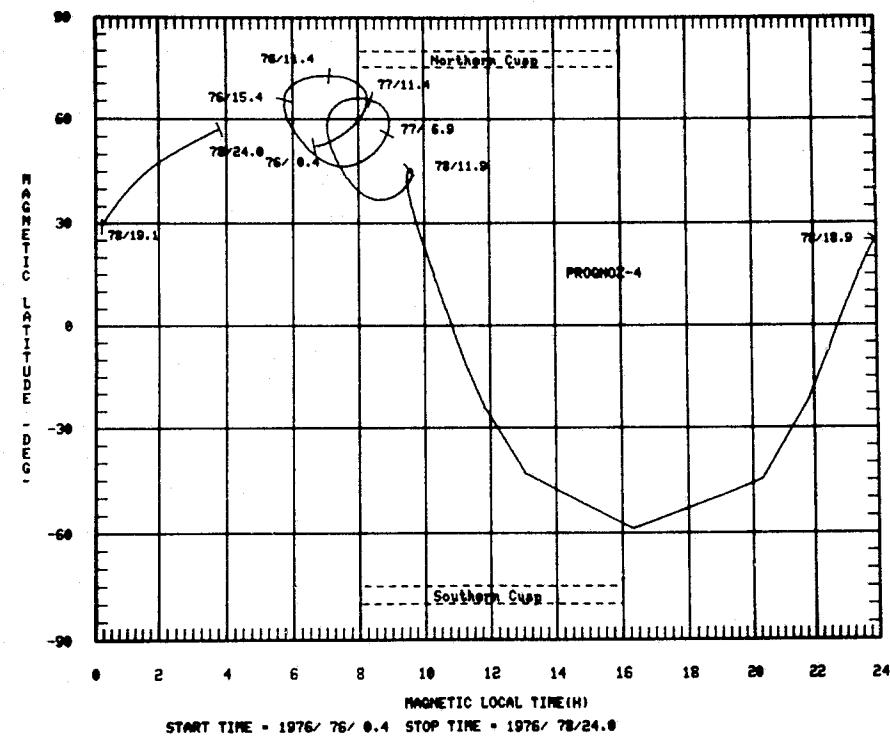
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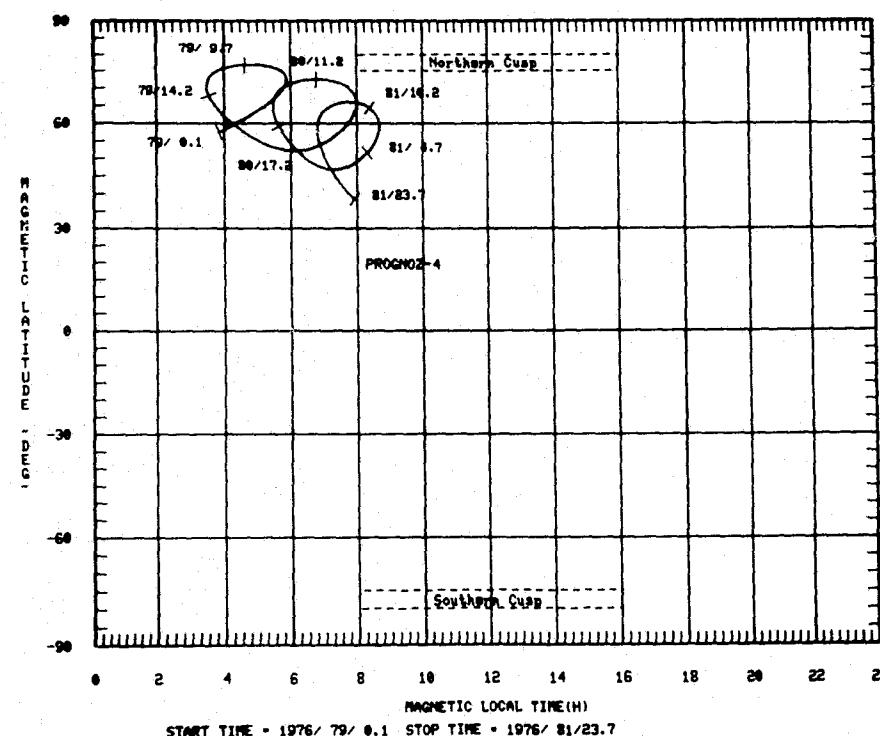
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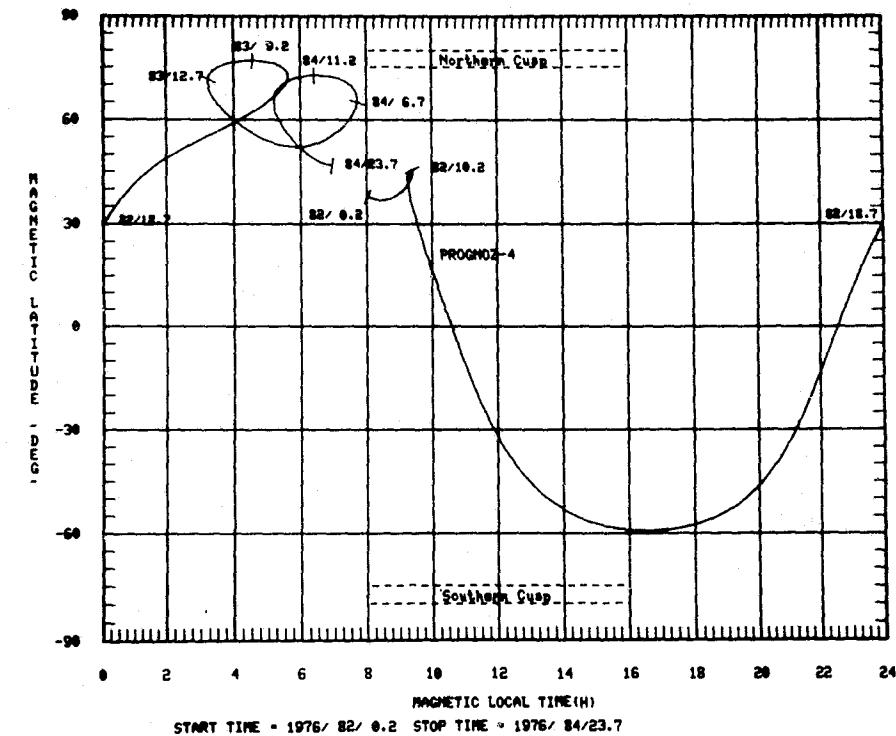
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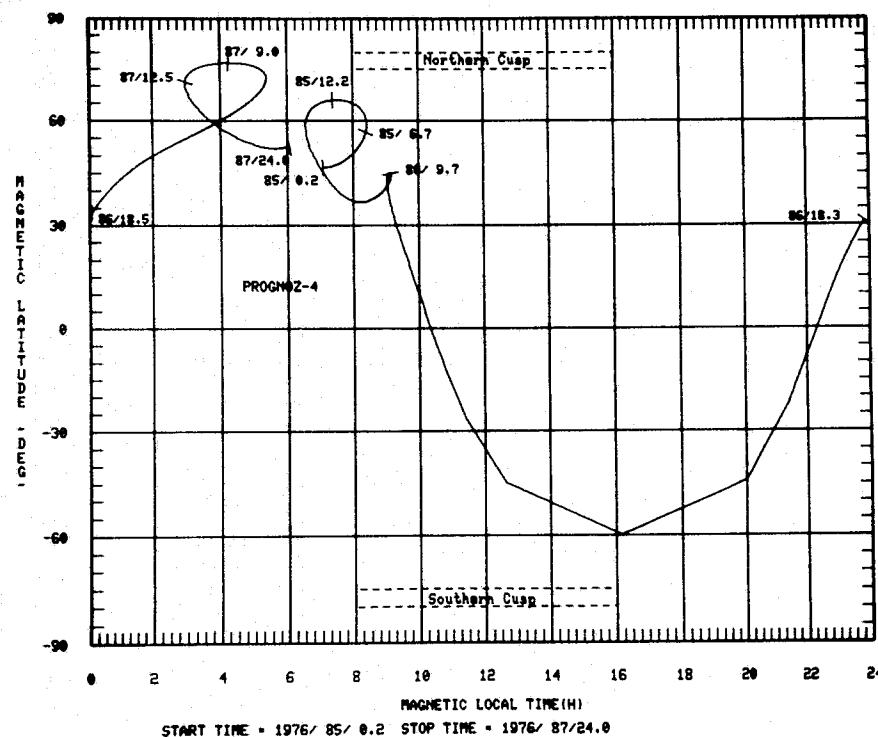
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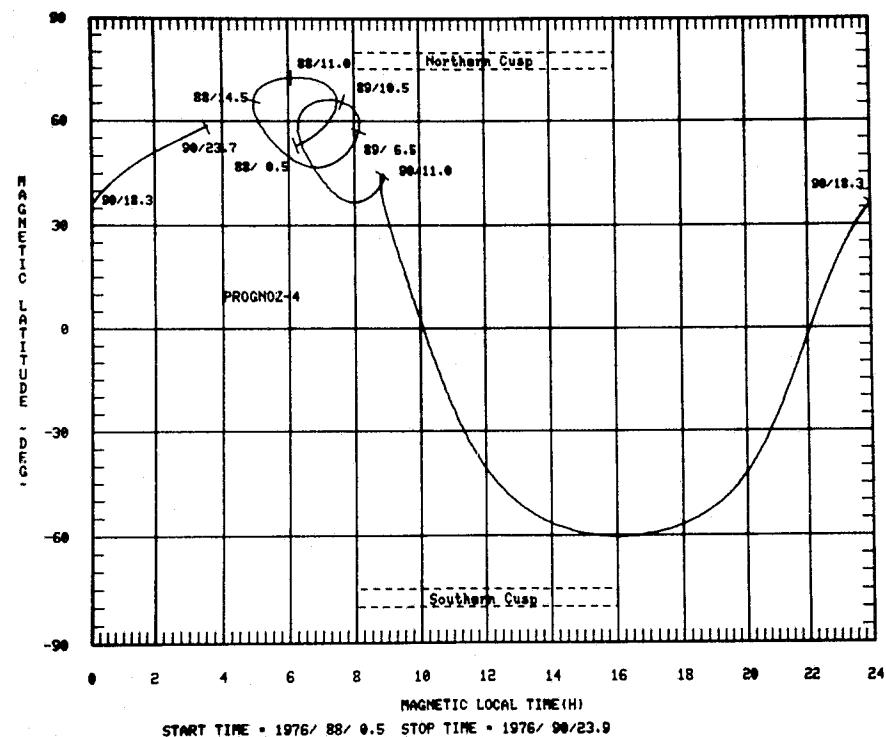
MAGNETIC LATITUDE-MAGNETIC LOCAL TIME PROJECTION



MAGNETIC LATITUDE-MAGNETIC LOCAL TIME PROJECTION



MAGNETIC LATITUDE-MAGNETIC LOCAL TIME PROJECTION



MAGNETIC LATITUDE-MAGNETIC LOCAL TIME PROJECTION

